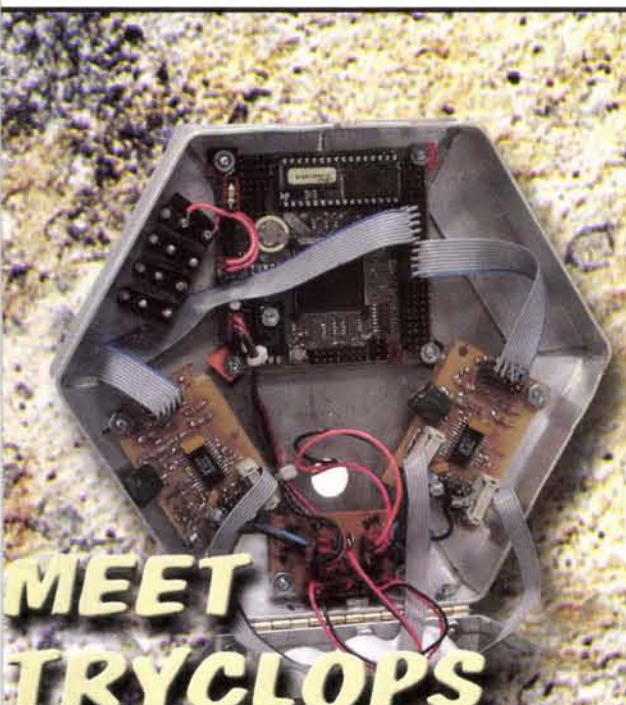
ROBOTICS · MICROCONTROLLERS · COMPUTER CONTROL · CIRCUITS

Nuts & Volts

EVERYTHING FOR ELECTRONICS!

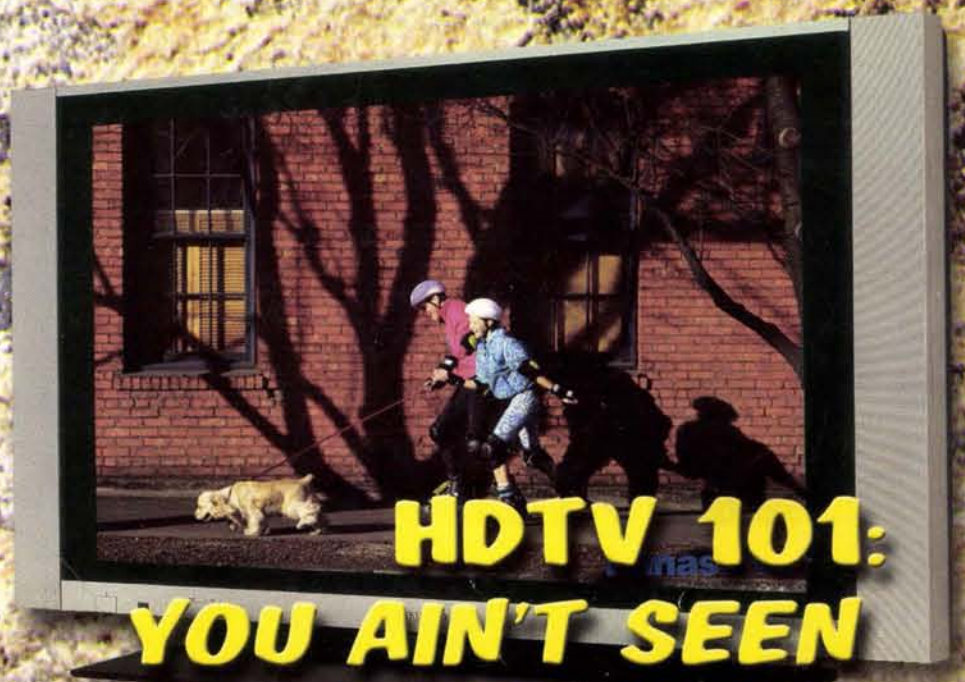
February 2001
Vol. 22 No.2



MEET TRYCLOPS

Six years of competition robot building results in:

FrenZy



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CYBER-STREET SURVIVAL

SPAM: JUST SAY DELETE

OOPICS IN MY PRESSROOM

BUILD AN RS-232 SERIAL I/O BOARD

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CLONE, TEST OR REPAIR ANY HARD DRIVE

$995!

- SUPPORTS IDE, SCSI, SCA & NOTEBOOK DRIVES
- COPIES AND SERVICES HARD DRIVES
- PRINTS TEST REPORTS ON YOUR PRINTER
- DATA RECOVERY MODE BUILT-IN

Copy entire hard drives with this pro service station. Set up any SCSI or IDE drive with your original software. Attach a blank drive and press start. Make copies quickly and easily.

Use the built-in drive service system to make used drives run like new! Eliminate defective sectors, and restore hard drives to error-free condition with the factory re-mapping system. Test hard drives for top reliability using the built-in test feature. Print analysis reports on any standard parallel printer. Get the technology used by drive repair services. Call today!

25GB MP3 PLAYER

$395!
after mail-in rebate

- PLAYS OVER 10,000 SONGS FROM HARD DISK!
- PLAYS STANDARD AUDIO AND MP3 CDs AND CD-R
- DOWNLOADS MP3 FROM CD-R TO HARD DRIVE
- POWER AMPLIFIER DRIVES SPEAKERS DIRECTLY

MP3 is here! Get high performance digital sound and store over 15,000 songs on hard disk. Download over 300 songs from a single CD!

Grab new music from the net. Use your PC to create custom MP3 CDs with just the songs you like. Load them to the internal hard drive for realistic, 3-D theater sound. Patented digital signal processing gives you crystal clear sound. No PC connection is required. Connect any stereo system, or directly power external speakers. Get digital sound and room-filling bass.

The hard drive organizes your music in folders. ID-3 tags display the title, album, and artist on a large LCD. Use the jukebox feature for an entire evening of great music. Play songs randomly or in sequence from the internal hard drive. Unlike CD changers, the A/V certified 25 GB hard drive won't wear out, even under continuous use. Call now and try your MP3 player tomorrow!

COPY ANY CD NOW NO PC REQUIRED

from $995!

- MULTI-FORMAT DUPLICATION - FAST AND EASY!
- DUAL 8X DRIVES MAKE TWO COPIES AT ONCE
- INTERNAL 25GB HARD DRIVE STORES IMAGES
- PRO AUDIO MODEL HAS SP/DIFF AND ANALOG I/O

Instantly copy music and CD-ROM compact discs. Make backup copies of your favorite music and software on rugged, permanent CDs. Produce discs quickly and economically. Make custom audio CDs with just the songs you like.

Use our dual drive units to copy two CDs simultaneously, or choose the Pro Audio modelto make crystal clear music CDs from any analog or digital source. Dupe-It copiers are totally self-contained. No additional software or hardware is required. Call today for more information!

MULTI DRIVE IDE DUPLICATORS

from $495!

- COPIES EVERYTHING, PARTITIONS, O/S, THE WORKS!
- BOTH STANDARD AND ULTRA, FOUR AND SEVEN DRIVE MODELS ARE AVAILABLE NOW!
- THE ULTIMATE HIGH SPEED PRODUCTION TOOL FOR SYSTEM BUILDERS AND CORPORATE MIS

Copy entire hard drives with ease. Multi-drive duplicators are an essential tool for dealers and system builders. Why spend hours installing and formatting drives when you can dupe them instantly? Work like the pros. Get your own multi-drive, stand-alone duplicators today. CSC offers a complete line of four and seven drive copiers in both standard and ultra versions. Ultra models transfer data faster than any hard drive! Rates of over 1GB per minute are supported.

Set up any IDE drive with all your original software. Attach blank target drives, and press "start". It's that easy! You can duplicate four drives in less time than it takes to copy one on a fast PC! Your duplicate drives will be identical, bit-for-bit perfect copies, with all the files, partitions, and information on the original drive. Building systems is tough enough. Why spend hours installing software? Save time. Save money. Call today and let us Fed-X your duplicator for a risk-free evaluation!

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Over 80% of the Fortune 500 depend on CSC products. Shouldn't you? Call today. Most orders ship within 24 hours! Call now for more information and a free price comparison guide. Quantity discounts are available for dealers and system builders. Copyright laws must be observed when duplicating CDs and hard drives. © 2000 CSC.

Circle #102 on the Reader Service Card.

HSC Electronic Supply

Serving Silicon Valley since 1964!

...brings you a potpourri of high-tech goodies for the techno-tinkerer!
For thirty years we have been your source for Silicon Valley exotica!

Network Print Servers

- Milan 'Fastport' Model 3100
- 10BaseT, 10BaseT2 & AUI
- Serial and parallel ports
- Includes power supply and IEC cord

HSC# 18387 **$45.00**

- Milan 'Fastport' Model 3100CX
- 10BaseT Ethernet network print server
- Serial and parallel ports
- Includes power supply and IEC cord

HSC# 18386 **$42.50**

56K PCMCIA MODEM!

- 3Com/US Robitics Model MDM-XJ1560J
- 56K, V.90 PCMCIA type
- Built-in XJACK for direct phone line conn.
- New, in jewel case w/cable
- 90-day warranty
- Drivers available at: http://www.mhz.com/support/drivers.cfm?model=XJ1560

HSC# 80559 **$39.95**

Browser Mouse!

- Wheel-type browsing mouse
- 3-button PS/2 interface
- Fully programmable
- Wheel also functions as a button
- New, 90-day warranty

HSC#80555 **$4.95**

Tiny Color Camera!

- Camera-On-A-Board, measures 1.87" x 1.3" x 1" thick
- Glass micro-lens element, not pinhole
- Std. NTSC composite video output
- 350 lines horiz. res., 7 lux sens.
- 4 - 5 VDC, only 150 mA! 3-AAA batteries would power it for over six hours!
- New, in OEM pkg (no box), 90-day warranty

HSC#18209 **$59.95**

486DX4 Motherboard!

- For 486SX/DX/DX2 and DX4 CPUs
- 128KB ram on board, expandable to 512KB
- Three PCI bus slots, supports 3 master/slave
- Four ISA slots, std. AT power conn.
- DIN kybd conn, 4-72-pin SIMM skts
- On-board IDE controller & conn
- Manual, driver diskette incl.

HSC#18529 **$19.95**

SCSI Drive Cases

Just in...two new styles of SCSI drive case. Perfect for those RAID systems, server backup, or other mass storage systems! Both feature: Power and drive status LEDs, front panel off/on switch, SCSI ID switch, fan-cooled switching power supply. Attractive beige color, curved front panels. Rear panel is punched for SCSI-1 (ICN-50) daisy-chain connectors, internal SCSI cable not included. Brand new in box, 90-day warranty

- Two-bay case
- RCA Jacks/ Sound Cable incl.
- Measures 6.3" x 7.0" x 11.25"
- 80-watt power supply

HSC# 18267 **$39.95**

- Four-bay case (similar styling to two-bay case above), no sound cable
- Measures 10.3" x 7.125" x 14.3"
- 200-watt power supply

HSC#18268 **$49.95**

...and two more cases!

- 3.5" compact SCSI cabinet
- Ideal for 1" high SCSI drives
- Built-in fan-cooled power supply
- Two 50-pin Centronics daisy-chain connectors & SCSI switch on rear panel

- New, with IEC power cord, 90 day warranty

HSC# 80545 **$9.95**

- CD-ROM drive tower case, made for Compaq Computer Systems
- Can handle 7 5/25" SCSI-I/II CD-ROM drives
- Includes 200W power supply, slides for drives
- Removable front and side panels
- Solid, heavy gauge construction
- Seven-position daisy-chain ribbon cable included
- New, 90-day warranty

HSC# 80544 **$89.00**

Disk Drive Deals!

- Seagate ST31722A 1.7 GB hard drive
- Great for back-up, add-on or small dedicated systems
- IDE 40-pin connector
- Used, tested good
- Standard 1" high 3.5" form-factor
- 90-day HSC warranty

HSC# 18502 **$32.50**

- Seagate ST32171N "Barracuda Ultra-SCSI"
- 3.5" 2.16 GB hard disk drive
- 7200 RPM, 9.4 mS access time
- Packaged for Motorola product
- Brand new, with slide brackets
- OEM (Motorola) box, 90-day warranty

HSC# 18388 **$49.00**

- Seagate ST15150N 4.3 GB "Barracuda"
- 7,200 RPM, 8.0/9.0 ms avg. seek time
- 21 Hds, 11 Disks, 3,711 Cyl.
- Standard 50-pin SCSI
- Half-height size (1.5" tall)
- Refurbs, 90-day warranty

HSC# 18412 **$75.00**

USB Video Camera!

- 'NetView' PC camera w/high-speed USB interface
- Up to 30 fps for real-time video
- 350,000 pixel, 1/3 inch color CMOS
- Auto white balance & color correction
- Retail boxed, with CD
- New, 90-day warranty

HSC#80554 **$37.50**

Tablet PC!

- 486DX4-100 MHz CPU w/monochrome LCD display
- 640KB + 7168KB extended ram
- 341MB hard drive (bootable)
- Serial/Parallel/Keyboard (PS/2) ports, stylus included
- Includes battery charger, carrying case and charger

HSC#80560 **$99.00!**

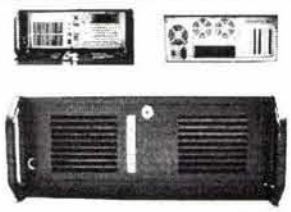
74 Min/650MB CDRs!

- Ultra high quality writeable CDs by Ricoh
- 74 minute, 650MB storage, 8X write class
- 10-piece retail pack
- Media in paper sleeves
- New, 90-day warranty

HSC#80552 **$3.95/10 pk!**

Rack-mount Chassis!

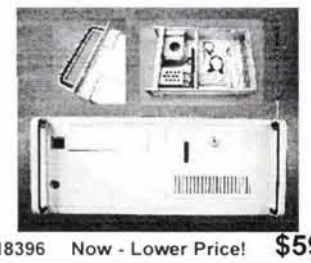
- Rugged construction for heavy duty server use
- Supports all standard ATX motherboards
- Industry standard 4U height
- 250W standard/350W surge high output supply
- Filtered cooling system, locking front panel
- Can mount up to ten drives
- Folding front handles, mounting ears & accessories
- Brand new, boxed with 90-day warranty
- Available in black or cream textured finish



HSC# 80540 **Black** **$195.00**
HSC# 80541 **Cream** **$195.00**

Do-It-Yourself Server Chassis!

- Standard 19" rack enclosure for 20-slot backplane
- 6.75"H x 24.25"D, heavy duty panels
- Brackets for 3.5" & 5.25" drives, power supply
- Front mounted 5-pin DIN with cable for keyboard
- Cabinet can be modified to accept AT-style motherboard (power extender cables included, some drilling required, no returns when drilled!)
- Hardware pack and IEC socket kit included
- Brand new, high-quality construction
- Includes 150W AT power supply!
- Inquire about higher wattage or ATX power supplies



HSC#18396 **Now - Lower Price!** **$59.00**

Headset for Gamers!

- Unique stereo headset has built-in mouse control!
- Keep your hands on the trigger buttons!
- "UR Gear" 3-dimensional "joystick" control
- Integrated stereo headphones, built-in microphone
- Even includes voice-recognition software!
- DOS, Win 3.1, Win 95 compatible, DirectX compliant
- Easy to install & use, full step-by-step manual
- 3-D position sense & movement detection
- 4-button hand control as well as voice command!
- Infrared pickup installs on monitor, parallel interface
- HSC 90-day warranty

HSC#18476 **$49.95**

Soft-Touch Keyboard!

- 'Windows 98' keyboard
- Large 'Enter', 'Spacebar' and 'Backspace' keys
- Four extra color-coded keys for: - Soft Power On - 'Sleep' mode - Wake Up - Function -
- New, 90-day warranty

HSC#80551 **$12.50**

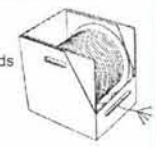
Removable HD Rack!

- Takes all standard 3.5" IDE drives, very high quality
- Also takes UDMA/100,/66 and /33 devices
- Mounts in 5.25 inch bay, twin cooling fans
- Includes dustcover and keylock (2 keys incl.)
- New, retail boxed, 90-day warranty

HSC#80553 **$14.95**

Cat5 Cable

- 350+ Enhanced CAT5e 100MHz Horiz. cable
- Four pair, #24 AWG solid
- UL/CSA TIA/EIA 561A
- Esceeds proposed 1 GHz standards
- Available in White, Blue and Grey



HSC#5E8XX1001 **$69.00/1000'**

Power Supply Specials!

- Lite-ON model no. PS-5151, 145 watts
- 5V @ 18A, 12V @ 5A, -12V @ 0.8A 3.3V @ 7A, +5Vsb @ 0.15A
- Hi-Pot tested w/large cooling fan
- Standard ATX Form-factor
- Brand-new, 90-day warranty

HSC# 18350 **$12.95**

- Lite-ON model no. PS-4151-9B, 150 watts
- 5V @ 18A, -5V @ .3A, 12V @ 4.6A, -12V @ 0.3A
- Hi-Pot tested w/large cooling fan
- Standard AT "Mini Tower" Form-factor
- Brand-new, 90-day warranty

HSC# 18351 **$14.95**

Halted specialties co. HSC Electronic Supply

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3500 Ryder St., Santa Clara, CA 95051 (408) 732-1573 -or-
4837 Amber Ln., Sacramento, CA 95841 (916) 338-2545 *FAX your orders to:*
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Watch HSC's Website!

- Changes are coming to our website...stay tuned!
- Simply point your browser to *http://www.halted.com*
- We plan secure shopping, with shopping basket!
- Or, you can email your orders to *hscmail@halted.com*

Weekly Web Specials!

- A new section has been added to our web page!
- Simply go to www.halted.com and click the top button!
- Items from our ads, as well as non-advertised items
- Also, you can download our catalog as Adobe PDF files

Terms: Some quantities limited; all items subject to prior sale. **Minimum order: $10.00 plus shipping.** Orders under $20.00 subject to $2.00 handling fee, in addition to shipping. All orders shipped FOB Santa Clara, CA (this means you pay freight!) by UPS Surface (no P.O. Boxes) unless otherwise specified, in which case prevailing carrier rate plus $5.00 handling fee applies. Prepaid orders that don't include shipping charges will be shipped freight COD. There is a $5.00 UPS charge added to shipping charges for COD shipments. If you have questions about your order, please call Customer Service at (408) 732-1854 M-F 9AM to 5PM PST.

Circle #105 on the Reader Service Card.

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VIEW SHOPPING CART

PCI WATCHDOG CARDS

32 bit Plug-N-Play PCI Watchdog timer adapter provides user selectable refresh timer to automatically reset the system. When the timer adapter is enabled, the system software or application program must refresh the Watchdog before selected time expires (500mS to 1hr.) otherwise the computer will be reset. Connects between Reset button and motherboard. Reboots computer should it "hangup". Status LED shows if system was reset. Pentium/AMD compatable. Watchdog I includes PCI card, Reset cable & application software (LINUX, OCX & drivers for Visual "C" & Visual Basic under Win98/NT/2000

Watchdog II. Includes everything in Watchdog I as well as a external power control box & cable to reset power to peripheral devices. **WT:** Watchdog I : 2 **WT:** Watchdog II: 4

12761-DC ..... PCI WATCHDOG I BOARD ..... $149.95/2+$119.95
12762-DC ..... PCI WATCHDOG II & POWER CONTROL ..... $295.95/2+$239.95

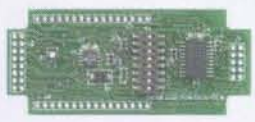
PCI 4/8 PORT RS232 COM BOARDS

32 bit Plug-N-Play PCI 4 or 8 port adapters provides auto detection by BIOS of IRQ and I/O address automatically, no need to set switches and jumpers. Provides 4 or 8 asynchronous serial communication ports (RS232), to link the computer to serial devices such as terminals, modems, printers, plotters, etc.

The adapter is particularly suited for the connection of terminals (VDUs) in multi-user operating systems. The board may be installed in any Pentium or hardware compatible systems. The adapter can be configured as COM4. On board ST16C554 ICs provides the function of 8 16550s with 16 bytes FIFO buffer for each ports. Normal speed mode supports baud rate up to 115200. High speed mode supports baud rate up to 460K. Up to 4 boards per system, with DB-9M or DB-25M breakout cable. **WT:** 2

12763-DC ..... PCI 4PORT RS-232 BOARD WITH DB-9 CABLE ..... $169.95/2+$139.95
12764-DC ..... PCI 4PORT RS-232 BOARD WITH DB-25 CABLE ..... $169.95/2+$139.95
12765-DC ..... PCI 8PORT RS-232 BOARD WITH DB-9 CABLE ..... $269.95/2+$219.95
12766-DC ..... PCI 8PORT RS-232 BOARD WITH DB-25 CABLE ..... $269.95/2+$219.95

UNIVERSAL LCD DRIVER BOARD



1 LINE X 16 CHAR. LCD DISP.

Free LCD

Serial driver board for 1 line X 8 character up to 4 line X 20 LCDs that use the Hitachi HD44780 controller IC. Provides all the "handshaking" needed by the LCD module. Board mounts to the back of LCD. Converts 110-19200 Baud serial data to parallel for the LCD. Access to LCD commands like scrolling, custom char. set etc. Works with Basic Stamp, PC Com Port & Single Board Computers with serial output port. Hole patterns allow use with LCDs with single row or 2 row pin configurations. Documentation.

Note that this unit is an interface and does not provide for terminal emulation; your software should "format" the data as in any LCD driver. **WT:** .1

12015-OP ..... UNIVERSAL LCD DRIVER BOARD WITH FREE 1X16 LCD $19.95

DATA SAMPLER KITS

DB-25 extended case package plugs into computer parallel port.

8 bit A/D Sampler monitors voltage changes over time. Software allows timed sampling from mS to months. Selectable 2V or 20V ranges. Useable as a low frequency digital "scope" for signals up to 5KHz. Powered from port. Includes Windows 3.1/95™ software to get started. Displays plot & data is saved as text files for import to spread sheets. Requires hard drive & VGA card to display plot.

12 Bit Analog Data Acquisition System monitors 4 digital inputs (TTL). 8 multiplexed analog inputs (0-4.096VDC. Drive external circuits with 4 TTL outputs. 'C', Visual Basic, Quick Basic routines provided along with Windows 95 software. Data can be viewed, stored or exported to Lotus or Excel. Requires external 12VDC @ < 100mA supply.

L: 2-1/4" **W:** 2-1/8" **H:** 3/4" **WT:** .1

8412-KT ..... 8 BIT DATA SAMPLER KIT $23.21
8418-KT ..... 12 BIT DATA ACQUISITION KIT $55.00

LAPTOP COMPUTER CARRYING CASE

Targus Notepac Plus padded case with non skid rubber feet & nylon zippers. Features padded computer compartment, expanding file pocket, 2 CD pockets, Disk pocket holds four 3.5" floppies, pocket for 2 PC cards, Workstation section has pockets for cell phone, disks, pens, 3 section accordion file for papers.

For computers up to 15" X 10.6" X 2.8" **WT:** 3.1

12786-CP ..... TARGUS LAPTOP CARRY CASE $34.95

24VDC PANCAKE MOTOR

24VDC pancake motor with tach. output. Front & rear ball bearings. Draws 120mA no load, 5A stall current @ 24V, 4325 RPM, 2225RPM @ 12VDC. 1/4" X 1-1/8" steel shaft with a pinned belt drive sprocket. 7" wire leads.

D: 4" **T:** 3" **WT:** 1.5

12771-MD ..... Pancake Motor $9.95

P.C. RELAY BOARD KIT

This kit allows your P.C. to control lights, solenoids and other heavy loads found in the real world. Kit supplies external relay board, eight 12VDC relays (5A contacts) & software for use under DOS or Windows 3.1. 36 pin centronics female input connector from printer port, terminal strip for relay contacts & relay power. You supply a external 12VDC supply for relays) & printer port cable. K-74

L: 8-1/2" **W:** 2-3/4" **H:** 1" **WT:** .3

6074-KT ..... PC Relay Board Kit $35.63

INDUSTRIAL POWER SUPPLIES

60W/100/150W

200W

Input: 110-240 VAC 50/60Hz
Specifications/Features: Enclosed switching supplies. .5% line, 1% load reg. 1% P/P noise/Ripple. Overload &overvoltage protected. Screw terminals. UL Listed.

12411-PS ..... 5VDC/12A $29.95
12412-PS ..... 12VDC/5A $32.95
12414-PS ..... 4VDC/2.5A $32.95
12417-PS ..... 12VDC/8.5A $39.95
12418-PS ..... 24VDC/4.5A $39.95

12422-PS ..... 12VDC/12.5A $44.95
12424-PS ..... 24VDC/6.5A $44.95
12425-PS ..... 48VDC/3.3A $44.95
12611-PS ..... 12VDC/17A $59.95
12613-PS ..... 24VDC/8.5A $59.95

LCD PANEL METER

3-1/2 digit Meter with 200mV input, .5" char. Ht., Adj. decimal point, auto polarity indicator, >100M ohm input impedance, 2 samples/sec. .;5% +-1 digit accuracy. Requires isolated 9VDC power.

W: 2-5/8" **H:** 1-3/4" **D:** 3/8" **WT:** .1

6929-ME ..... LCD Meter $7.95
(25+ @ $6.40 100+ @ $5.95)

DIGITAL PANEL METERS

3-1/2 digit, 200.0mV DC basic input, .8" character height, DPMs with black plastic face. adj. decimal point, auto polarity, >10Mohm input imp. 2 readings/sec., 0.5% accuracy. Snap-in panel mounting. **5VDC powered**. Power must be isolated from input. NOTE: THESE METERS CANNOT MONITOR THEIR OWN POWER. Built in scaling resistors for 20V & 200V ranges

W: 3-3/8" **H:** 1-5/8" **D:** 1" O/A **WT:** .13

12306-ME ..... 5V LCD Meter $9.95
12308-ME ..... 5V LED Meter $12.95

SONY COLOR CAMERA

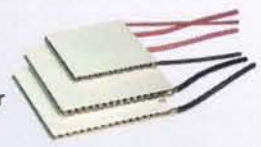
Sony CCB-GL5 1/3" Color board camera. 2 board assembly with sensor/lens board that connector mounts at right angle to main board. Lens: 6.5mm. Resolution: H-320 V-350 lines. Min sensitivity: 5lux. Scanning: 525 lines; 2:1 interlace @ 30 frames/sec. 1V P/P NTSC composite video out. 9VDC @ 175ma power.

Sensor: L: 2" W: 13/16" D: 1-1/4
Main: L: 3-3/8" W: 2-3/16" D: 5/16
WT: .1

12742-ST ..... Sony Camera $49.95

12V THERMOELECTRIC COOLING MODULES

127 Couple Peltier Modules Optimized for 12VDC.



70W (~170 BTU) heat pumping possible. 8A max, 16V max, Draws 6A@ 12VDC
L: 1-11/16" **W:** 1-9/16" **T:** .127" **WT:** .06
12326-PM ..... 70W Module $17.95

50W (~125 BTU) heat pumping possible. 5.5A max, 16V max, Draws 4.8A@ 12VDC
L: 1-11/16" **W:** 1-9/16" **T:** .18" **WT:** .06
9080-PM ..... 50W Module $14.95

38W (~90 BTU) heat pumping possible. 3.9A max, 16V max, Draws 3A@ 12VDC
L: 1-3/16" **W:** 1-3/16" **T:** .13" **WT:** .03
12323-PM ..... 38W Module $11.95

DATA SWITCHES

Two set types available:
Computer sharing Set connects 2 printers to a computer. Includes: Heavy duty, metal cased A/B switch with DB-25 F connectors; One 6ft. DB-25M to DB-25M cable & two6ft. DB-25M to Centronics Cables.
Printer sharing Set connects 2 computers to a printer. Includes: Heavy duty, metal cased A/B switch with DB-25 F connectors; Two 6ft. DB-25M to DB-25M cables & One 6ft. DB-25M to Centronics Cable.
WT: 2.9

12692-SW ..... Two Printer Set $5.95
12694-SW .... Two Computer Set $5.95

PIR MOTION DETECTOR MODULE

PIR module with only 3 connections. Dual element detector element designed for human body detection. 5-10VDC input power. Active high output with a pulse width of approx. .5 Sec. (remains active as long as there is motion). Detects motion up to 10ft. Add a small relay to interface to higher power loads.

L: 1-3/8" **W:** 1" **H:** 3/4" **WT:** .2

7860-KT ..... PIR Module $9.95

13.5V @ 20A TRANSFORMER

Input: 115 VAC 60Hz
Output : 13.5VAC @ 20A
6" Wire leads on Pri.
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Contents

Articles

Page 6

Page 52

Page 91

Columns

Classified Ad Index

Departments

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by Michael Dennis

OOPics in My Pressroom

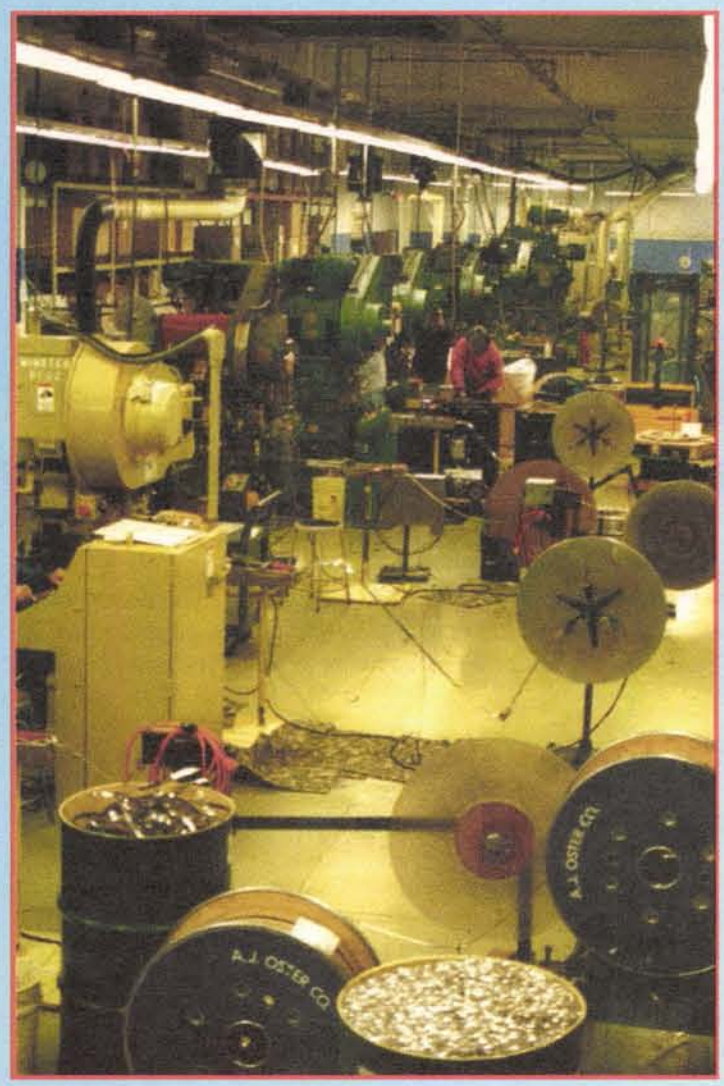


Figure 1. A cozy industrial environment. If you look carefully, you can see the conduit in the ceiling that connects the presses. This will be reused to wire the OOPic network.

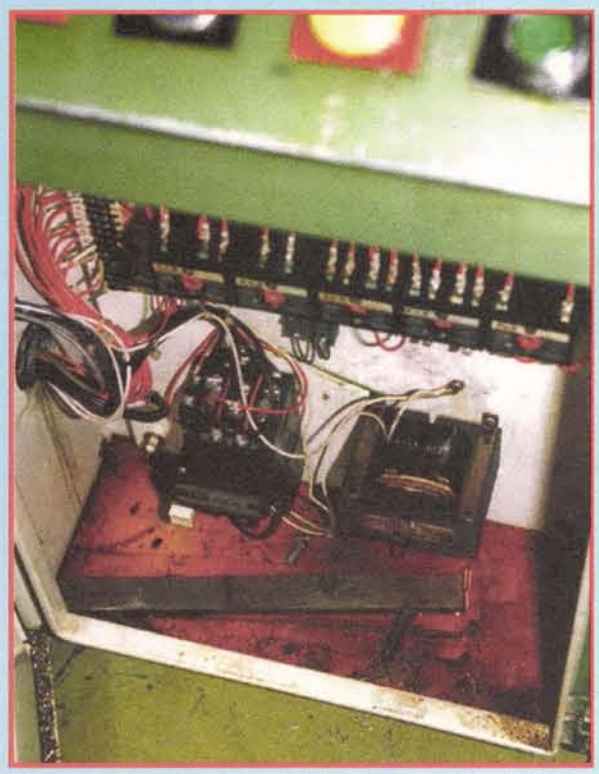


Figure 2. Real-world data collection isn't always pretty! This panel is typical for presses that have seen 20-30 years of service.

My nightmare scenario would be trying to write assembler for a microprocessor, interface it to sensors, build boards and enclosures, and tie it to a network while trying to maintain a semblance of a budget.

Posing the problem

I work for Die-Tech, a company that stamps metal for the electronics industry. We have reached a size where gathering sufficient data to make intelligent management decisions has become difficult. Our basic questions are these: Is a press running? No? How long has it been down?

The traditional response to this situation would be to purchase a SCADA package — that's Supervisory Control and Data Acquisition, tenderfoot — in the $30,000-$50,000 range, and hard-wire it to each press. But we have gone this route on four previous occasions and, in each case, the hardware failed in the field. And the software defied integration with our existing information system.

Our pressroom is a hostile environment for electronics. In Figure 1, you can see 14 high-horsepower motors, with fluorescent lights overhead to add to the electrical noise. Each press generates 10-30 tons of pressure on each stroke, adding an awesome vibration problem. On top of that, each stroke atomizes oil and metal, coating everything in a conductive slime.

Here's what's in the electrical panel (Figure 2) — that's oil in the bottom of the cabinet. Would you want to connect your fresh wiring to this mess?

On the other hand, homebrew electronics tend to be temperamental, with long incubation periods and insufficient features to support further development. My nightmare scenario would be trying to write assembler for a microprocessor, interface it to sensors, build boards and enclosures, and tie it to a network while trying to maintain a semblance of a budget.

Simplify the task, fit it to standard components

I needed to strip this task to the basics, and find cost-effective products that delivered a working package in less than 60 days.

This is the MUST HAVE list:

- Count press strokes.
- Calculate speed in strokes per minute.
- Notify a supervisory PC of stoppages within 30 seconds.
- Display count, speed, and elapsed downtime for the operator.
- Provide hooks to Microsoft Access for the MIS programmer.

Further, there had to be a way to connect to each press without regard to its current electrical layout. Some of these machines use 120VAC for control, some use 12VAC, some 24VDC. Aside from the complexity of isolating my devices from this broad range of voltages, documenting each press would be a headache.

Picking the hardware

I first thought of using the Parallax BASIC Stamp for this project, but a cost analysis left it wanting. You get a microprocessor but no support circuitry. By the time I added a prototyping board and peripherals, the cost rivaled a small PLC.

Since the Stamp is PIC-based, I went searching on the net for PIC tools and found the OOPic by Savage Innovations. In one compact package, this device provides a processor, headers for power, I2C networking, I/O, and a generous prototyping area (Figure 3). It also has a free compiler and inexpensive cabling.

Object oriented software

OOPic stands for Object Oriented Programmable Interface Chip. Object Orientation is the best part of the package. The compiler provides a set of objects that perform frequently-used functions. For example, there is a real-time clock, logic gates, and an LCD driver. Each object has handles that let it link to other objects to create what are called virtual circuits.

The virtual circuit behaves like an electric circuit, so instead of writing code to handle every event, you set it up once and it keeps working in the background while the main code moves on to other tasks.

The language model is event driven. Code gets quite compact, since there is no need to poll for events. Anyone who has written for Visual BASIC will be at home with this language. Incidentally, the compiler supports BASIC, C, and Java syntax, although you select "one only" for your entire project.

The I2C protocol was designed by Phillips Electronics to allow simple connections between a microprocessor and a peripheral device. Since I2C is built into the OOPic, it is easy to attach EEP-

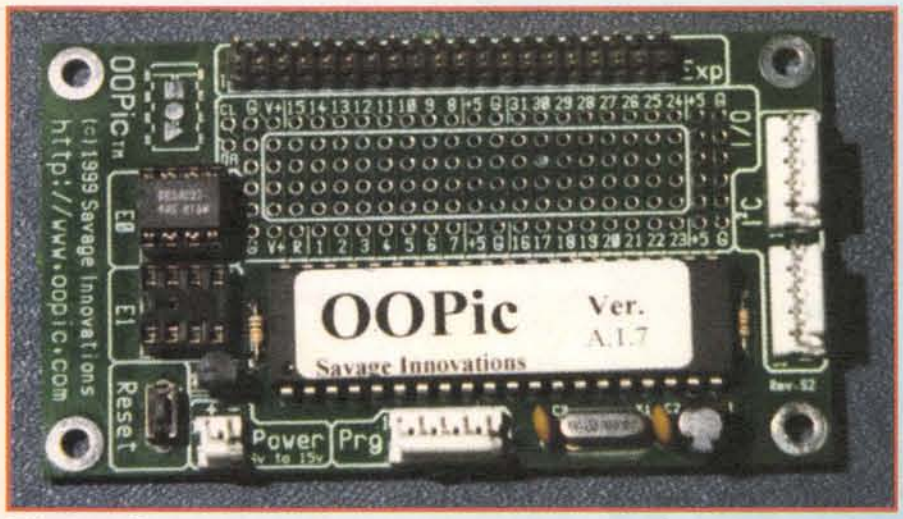


Figure 3. Your basic OOPic: clockwise from top, 40-pin I/O header, two I2C connectors, oscillator circuit and PIC, programming port, power connection, reset button, two EEPROM sockets. The rest is prototyping area.

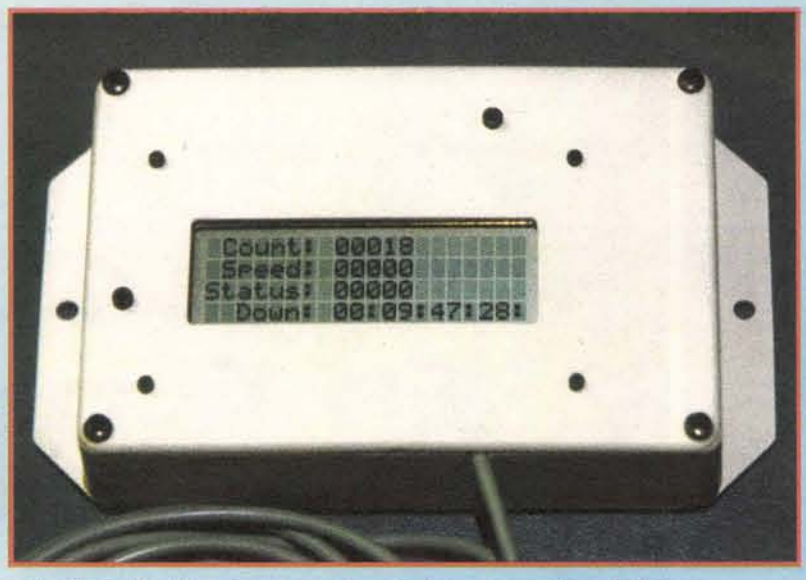


Figure 5. The local display derives a wealth of data from one input.

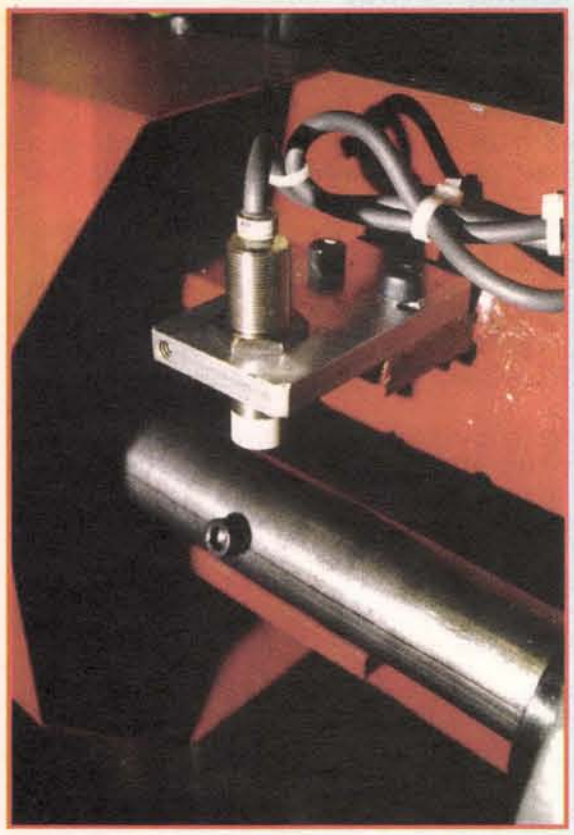


Figure 4. Proximity switch installed in a press. The screw head on the shaft triggers one pulse per revolution.

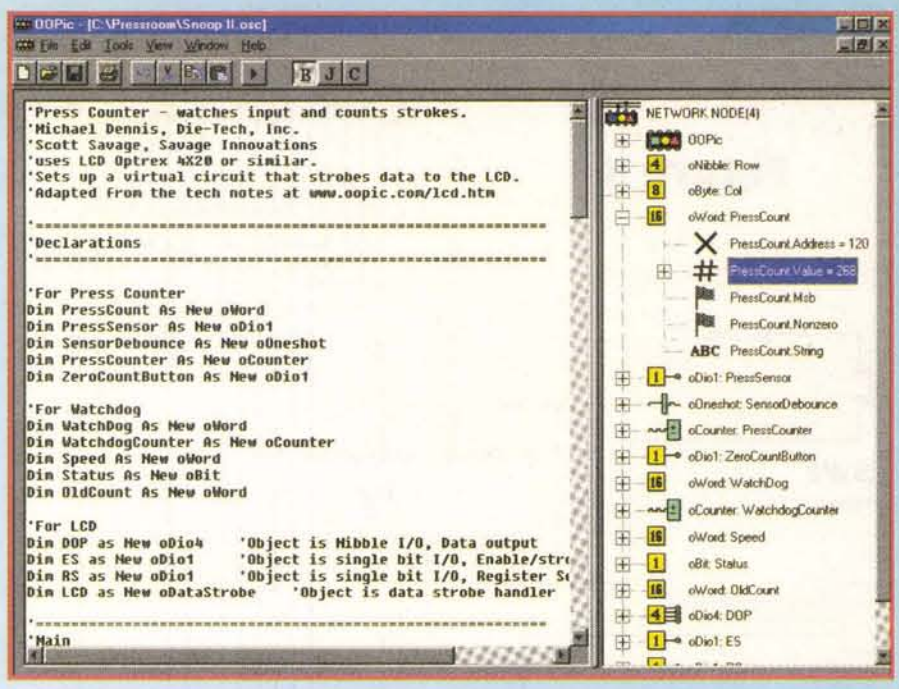


Figure 6. Screen shot of the compiler. The object listing to the right shows the location of the counter at 120, and its current value 268.

ROMS or AD converters, or even another OOPic.

This made the OOPic a good match for my needs. I could use I2C to pass data as needed. I could use the prototyping area to mount my sensors and LCD. And I could use BASIC to write the code. All at a price that reduced the project risk to nil; if the project failed, I could afford to throw away the OOPic.

Input and counting

All the data I needed from the press could be gotten through a proximity sensor. Figure 4 shows an Omron prox mounted to the press. By powering this sensor from the OOPic board, I achieved electrical isolation from the press. On each stroke it generates a pulse, which the software handles as shown below.

First the objects need to be created

```
'For Press Counter
Dim PressCount As New oWord
Dim PressSensor As New oDio1
Dim SensorDebounce As New oOneshot
Dim PressCounter As New oCounter
Dim ZeroCountButton As New oDio1
```

Then they are configured for operation. In this case, the oDio1 object needs to be assigned to a "real" hardware port. The direction (Input or Output) is established, and the object is linked to a counter using a oneshot.

```
'Set up reset button
 ZeroCountButton.Ioline=9                    'channel #9
 ZeroCountButton.Direction=cvInput  'is input
```

```
'Set up counter
PressSensor.Ioline=8                                    'channel #8
PressSensor.Direction=cvInput                           'is input
SensorDebounce.Input.Link(PressSensor.Value)            'Debounce the Sensor Input
SensorDebounce.Operate = cvTrue                         'Start the debouncer
PressCounter.ClockIn1.Link(SensorDebounce.Result)       'Use as input to counter
PressCounter.Output.Link(PressCount.Value)              'Link to Press Count
PressCounter.Operate=cvTrue                             'start it up
PressCount = 0
```

This virtual circuit does all the hard work — it gets a pulse from the sensor, debounces it, and counts the pulses. As long as its Operate property is true, it works in the background, so an accurate count is always available.

Speed calculation

Once a count has been established, it is simple to derive speed. It's pulses per time base scaled to pulses per minute.

This code fragment does the set-up for a timer. It is linked to the internal one-second clock of the OOPic.

```
'For Watchdog
Dim WatchDog As New oWord
Dim WatchdogCounter As New oCounter
Dim Speed As New oWord
Dim Status As New oByte
Dim OldCount As New oWord
...
```

This code fragment is continued on page 81

SIDEBAR

Building the Data Monitor

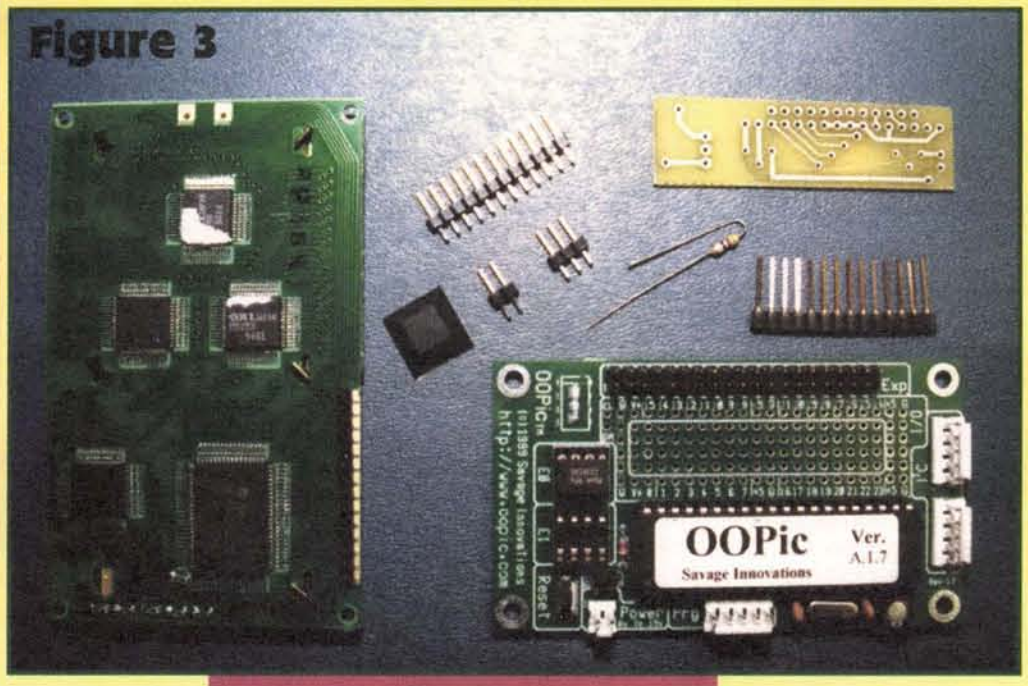


Figure 3

Design work

Figure 1 shows the schematic for the data monitor. The sensor is an Omron three-wire type. The reset switch wasn't installed, as the I2C network can provide this function.

Figure 2 shows the board layout. The board is sized to fit in the prototype area of the OOPic.

Construction

Figure 3 shows a kitted data monitor. Since the LCD I choose has no backlight, I omitted that pot. The board also has pads for a pot on the contrast pin, in case I ever need to use the circuit in an application that requires adjustable contrast for the data monitor, a fixed 470 ohm is all that's needed.

Start construction by locating the 14-pin connector in the prototyping area. (If the LCD had a backlight, this would be a 16-pin socket.) Figure 4 shows the socket in place.

In Figure 5, the socket has been placed and soldered from the component side. The header pin strips are put in place, but not soldered. This allows a little play as the LCD daughter board is placed.

The daughter board is populated before mounting. Figure 6 shows the connector for the speed sensor and the contrast resistor soldered in place.

The board is placed over the pins on the OOPic. Note the bus wire used to connect the pads on the left hand side of the daughter board in Figure 7.

All pins soldered (don't forget the solder side of the OOPic!) in Figure 8. Trim the bus wire connections.

Programming

Figure 9 shows the programming setup: a 9V battery supplies power, and the programming cable is connected to a PC running the OOPic Compiler. Since each controller is an I2C device, it needs to have a hard node address set before downloading the program. If you look at the label, you'll see that this one is assigned node 3.

The OOPic is assembled to an LCD module and tested in Figure 10. It is now ready for mounting on the press. The LCDs I used already have a pin header installed, otherwise, you would have to find one and solder it in place.

The rubber bumper shown in the kit is placed where it will keep the OOPic from shorting the LCD – usually on the corner next to the power connector.

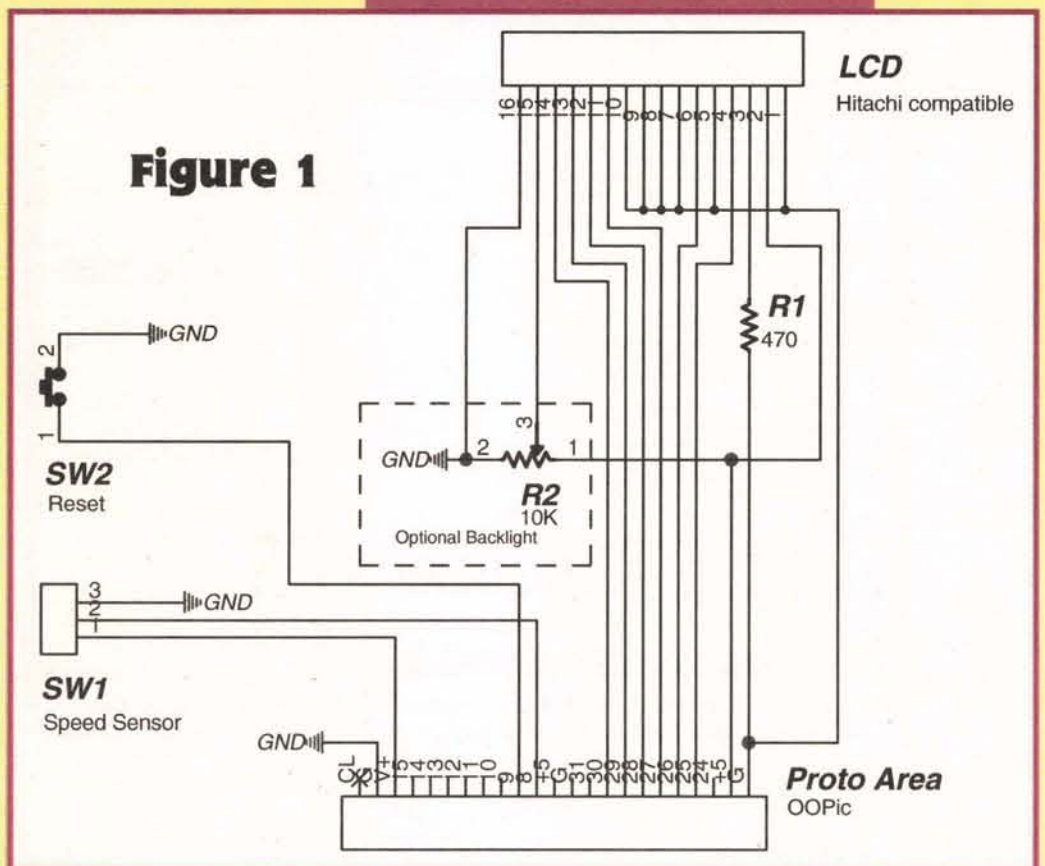


Figure 1

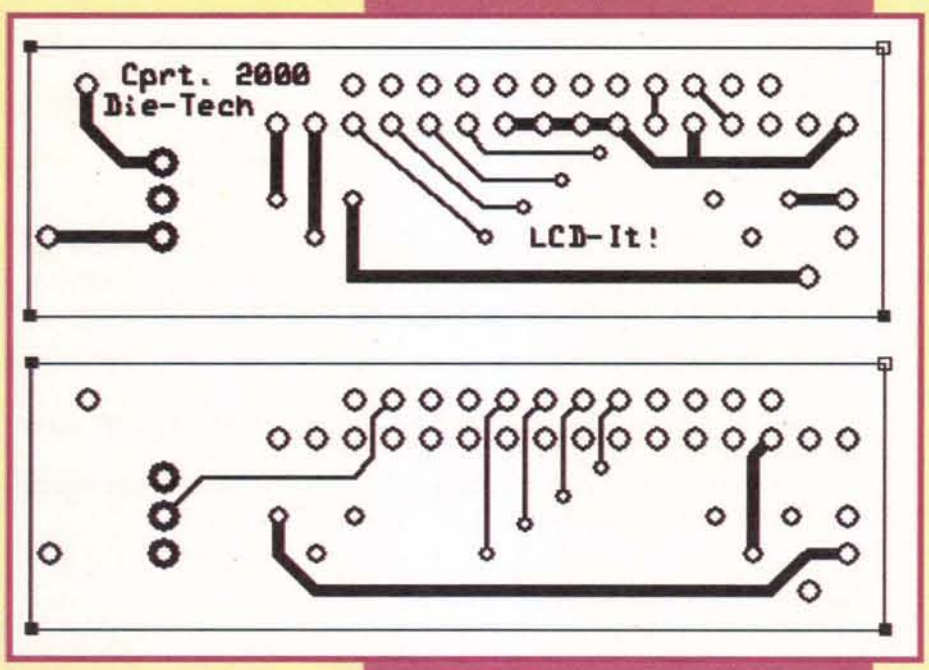


Figure 2

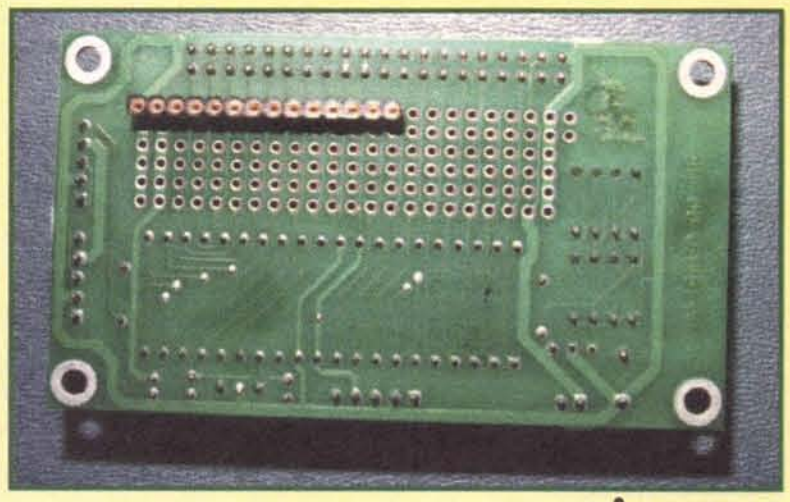


Figure 4

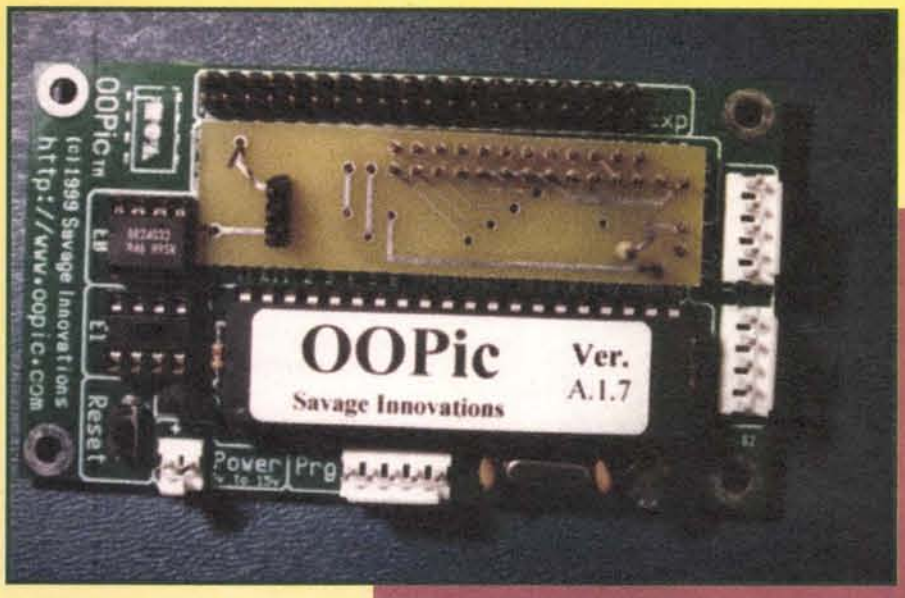


Figure 7

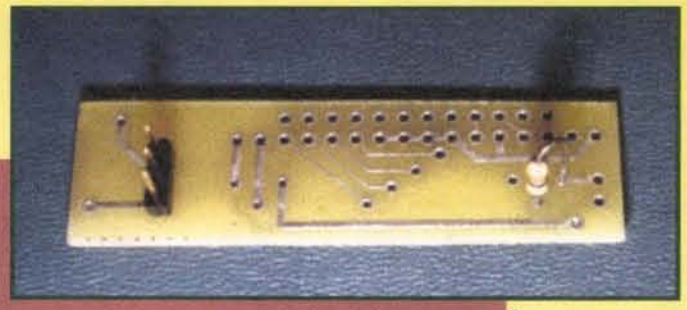


Figure 6

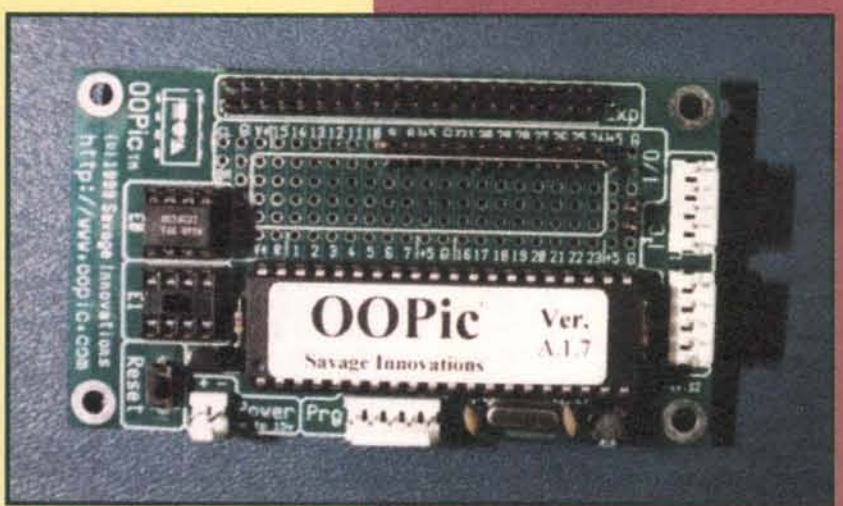


Figure 5

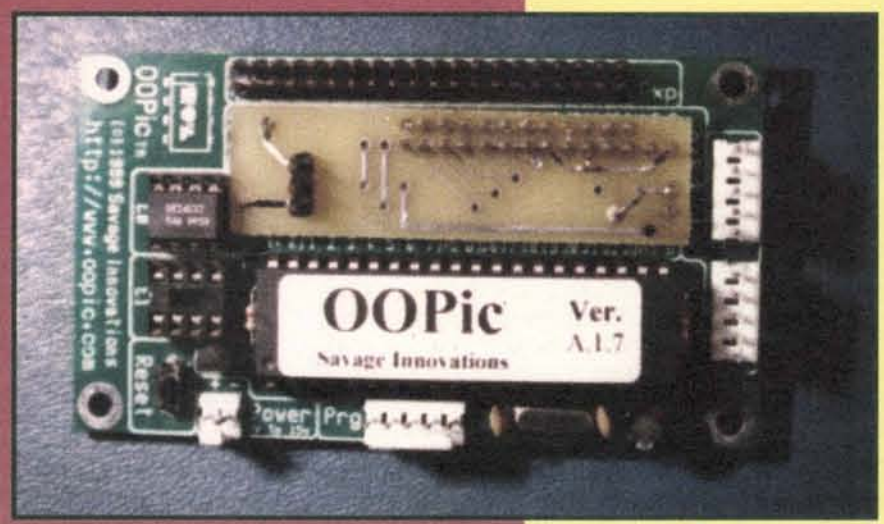


Figure 8

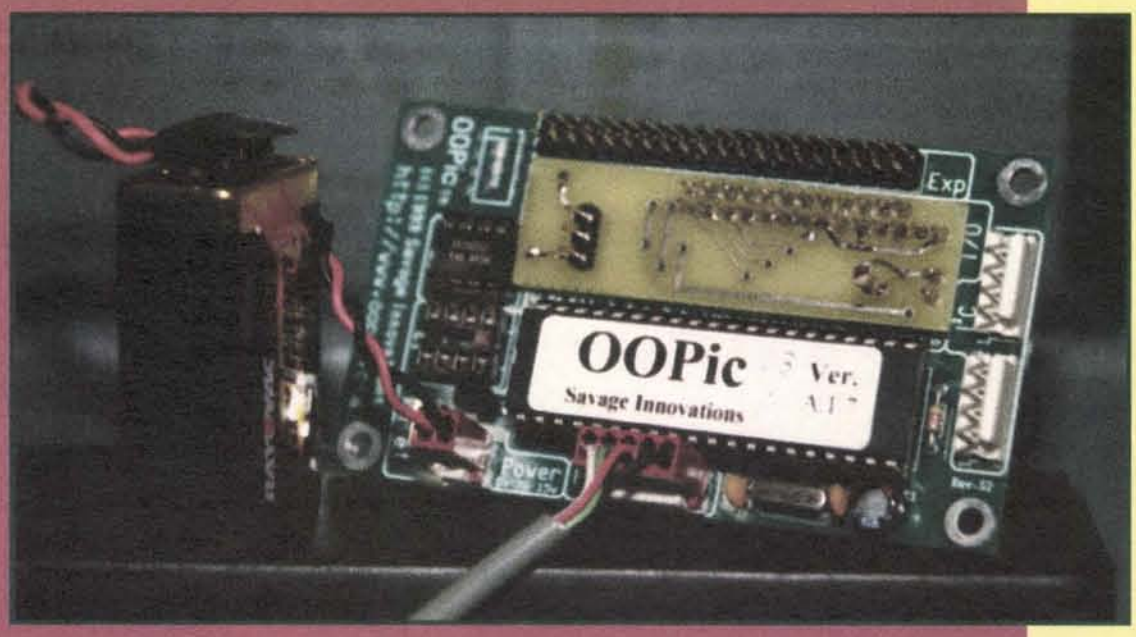
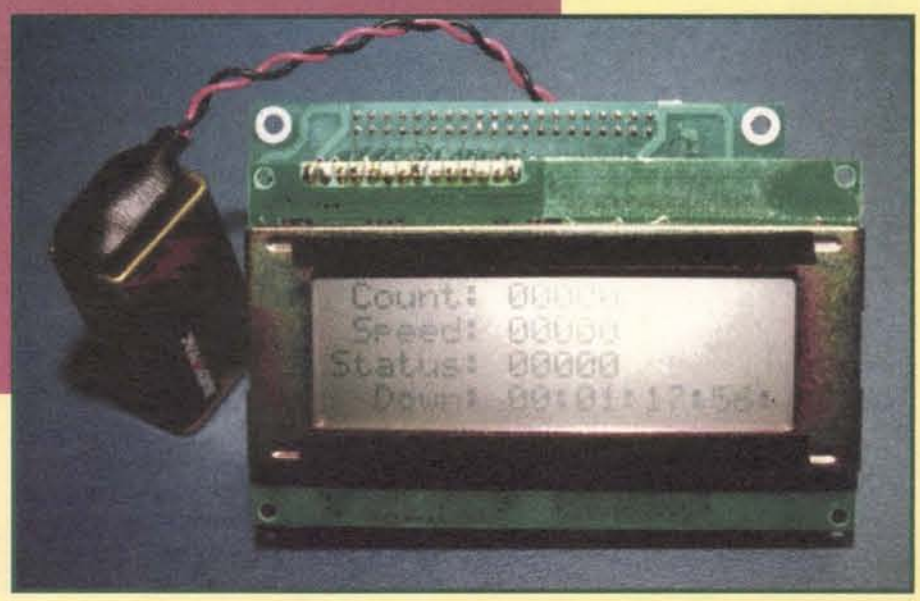


Figure 9

Figure 10



PARTS LIST

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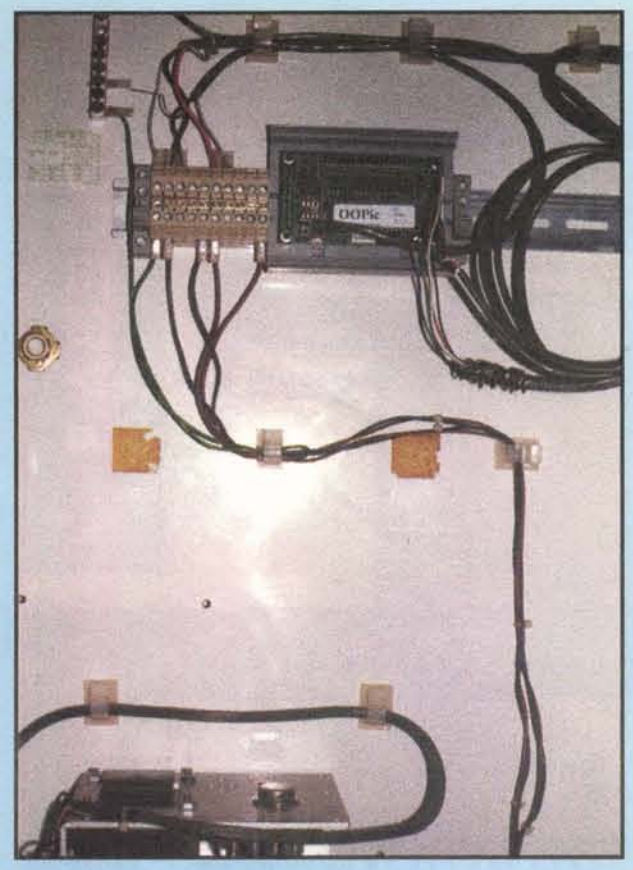


Figure 7. Node 127, the link between the presses and the PC. The power supply at the bottom provides 15VDC for the system. The box was inherited from a previous attempt at data collection, and has plenty of room for options.

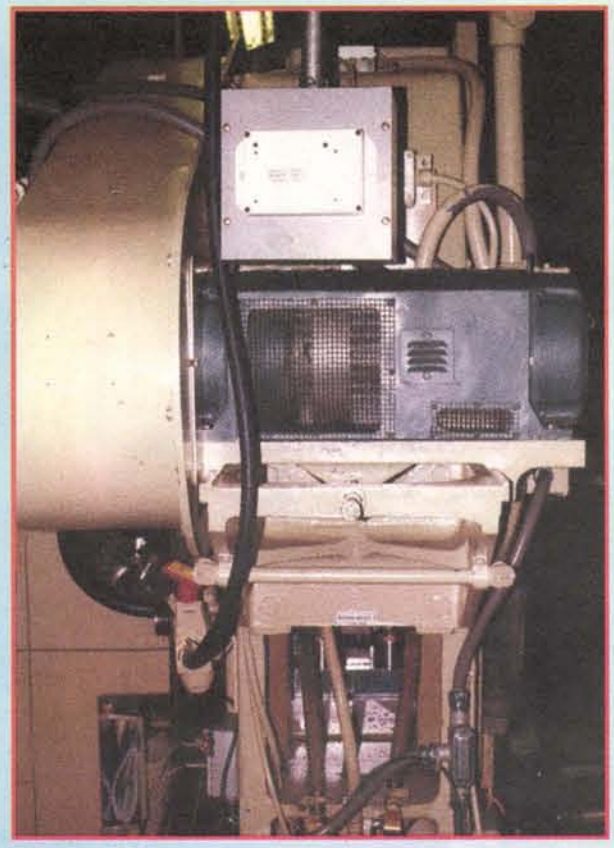


Figure 9. Installed and operational. The gray pull box holds the bulk of the network cabling so it isn't hanging off the OOPic connectors.

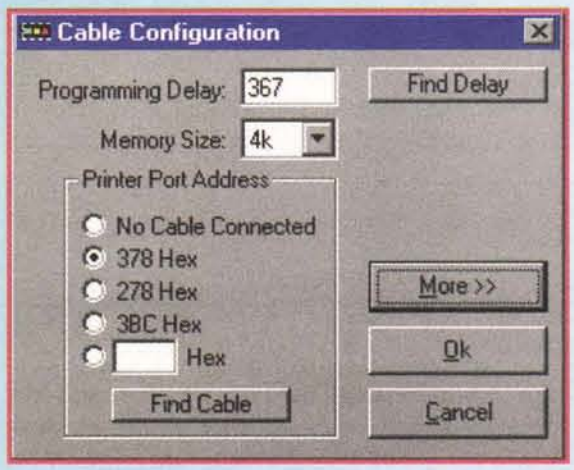
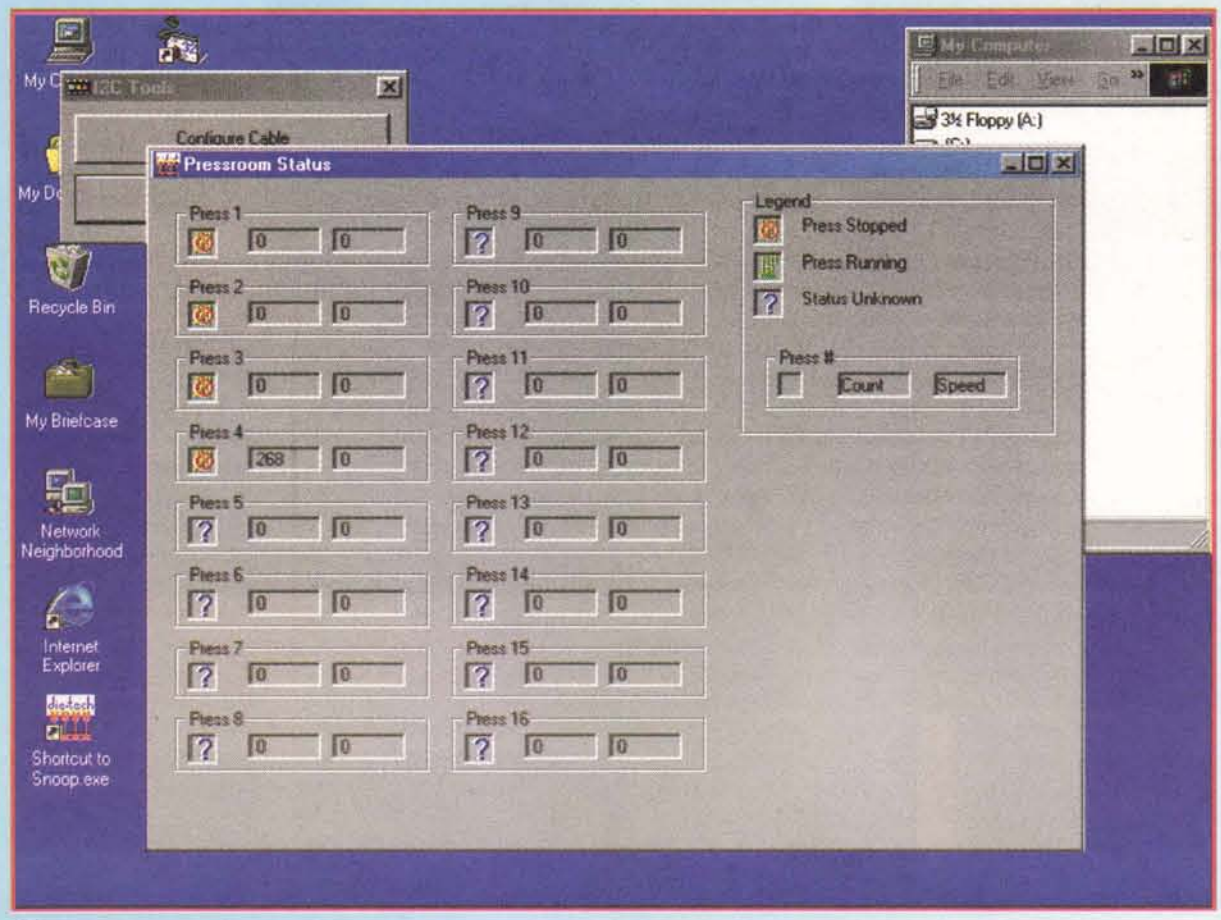


Figure 10. Setting cable delay.

Figure 11. Screen shot of the software. Critical information is right where a supervisor or operator can see it.




```
Private Sub ScanTimer_Timer()
Dim Node As Byte
Dim LinkAddress As Byte
Dim LowByte As Long
Dim Count As Long
Dim Speed As Long
Dim Result As Byte
Dim TempString As String

Screen.MousePointer = vbHourglass
For Node = 1 To 16
  LinkAddress = 113
  Result = 0 'clear flags
  FetchByte Node, LinkAddress, LowByte,
Result
  If Result <> 0 Then   'check Flags
    PressStatus(Node).Picture =
PlaceHolder(2).Picture
    TempString = Result
  Else
    ' Set the display to the value just read.
    Select Case (LowByte And 128)
      Case 0   'not running
        PressStatus(Node).Picture =
PlaceHolder(0)
        TempString = "0"
      Case 128  'running
        PressStatus(Node).Picture =
PlaceHolder(1)
        TempString = "1"
      Case Else  'oops!
    End Select
  End If

  'A note on this TempString stuff:
  'Each VB control has a Tag attribute that can
  'be used for any string data
  'and VB ignores it - it means nothing until the
  'programmer provides a context.
  'So by converting status code to strings, I may
  'store them in Tag for the next
  'read cycle. It is essentially an array of flags,
  'only there is no need to explicitly
  'declare and manage an array separate from
  'the controls.

  'if TempString is "0" data will be count, so
  'read counter
  LinkAddress = 120
  Result = 0
  FetchWord Node, LinkAddress, Count, Result
  CountData(Node).Caption = Str$(Count)

  'if TempString is "1" data will be speed, so
  'read speed
  LinkAddress = 114
  Result = 0
  FetchWord Node, LinkAddress, Speed, Result
  SpeedData(Node).Caption = Str$(Speed)

  'Make a record for each press
  If TempString <> PressStatus(Node).Tag Then
     'store a record
     Dim tb As Recordset
     Set tb = db.OpenRecordset("Events")
     tb.AddNew
       tb("Device") = Node
       tb("DTG") = Now
       tb("Event") = TempString
       Select Case TempString
         Case 0
           tb("Data") = Count
         Case 1
           tb("Data") = Speed
         Case Else
           'if TempString is anything else, we can't
read, so no read
           tb("Data") = 0
       End Select
     tb.Update
     PressStatus(Node).Tag = TempString
  End If
Next Node
Screen.MousePointer = vbDefault

End Sub
```

Figure 8. Code Listing. This routine is linked to a timer and does all the data collection.

Continued on Page 81

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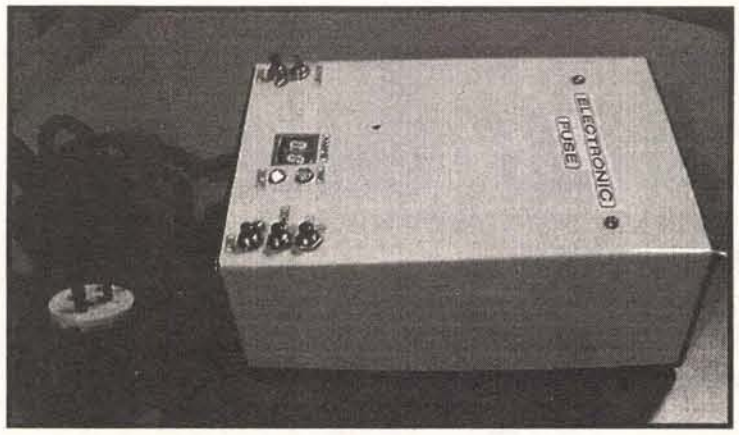
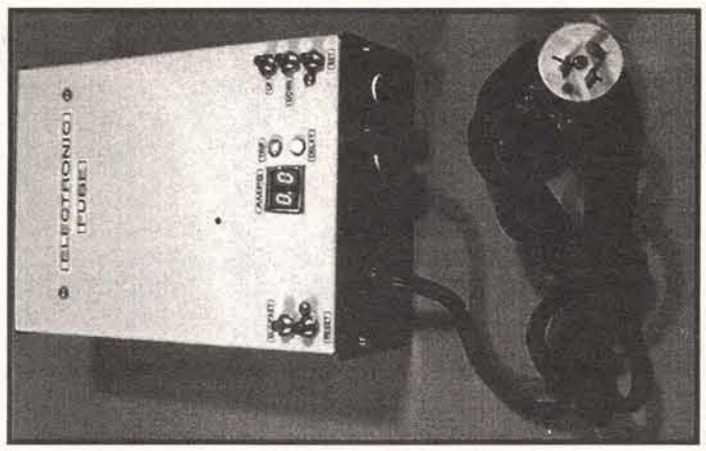
News Bytes

PROTECT YOUR WORKBENCH FROM COSTLY REPAIRS DUE TO OVER-CURRENT DAMAGE WITH EFUSE

[by Ken Vallelonga Sr. and Bill Allman]





I own a television service center and whenever we install new parts into a TV receiver, we need to be sure that it is safe to power up the TV set after a repair. If there are still unknown problems in the TV, there can be excessive current draw and that can destroy the parts you have installed, as well as other parts. That happened to us on occasion. So, I needed a way to quickly turn the power off when the set under test still had a problem, thus the idea of the *Efuse* (Electronic Fuse) was born.

First, I built a lower non-digital version of the *Efuse*. It had a rotary switch for setting the current and was adjustable from 0.5 to 6.0 amps. When the set that is powered by *Efuse* is turned on, if there is still a problem in the set, the *Efuse* shuts the power off almost instantly.

The first *Efuse* unit needed a lot of improvements because it was too slow and not very precise in the current settings. (Current was set on a mechanical rotary switch without LEDs.)

After breadboarding and re-design, we went to work on a new CMOS microcontroller version for precise and fast action. Now you can adjust the *Efuse* to any current setting from 0.0 to 9.9 amps in tenths on LEDs.

The new *Efuse* (patent pending) is very fast acting, it shuts the power off in less than 1 ms, and the current settings are accurate. The *Efuse* displays the operating current in amps of the device under test on the LEDs while it is on. Should the operating current exceed the user's preset level, power is removed from the device under test in 1 ms (in normal mode) simulating a fast-blow fuse and 250 ms (in delay mode) simulating a slow-blow fuse. We can precisely imitate an actual fuse in the programming software of the chip, imitating chemical or wire fuses.

The *Efuse* can be used for consumer or industrial applications, and I believe the *Efuse* will save a lot of time and expense on the bench for engineers and technicians alike. The cost to build the *Efuse* is economical when considering that a comparable device on the market sells for over $900.00.

The programmed microcontroller, bill of material (BOM), and schematics are available from Callsaver for $39.95 plus $2.50 shipping and handling. With this offer, you can build the complete Efuse for about $125.00 if you use the listed sources in the BOM. We will be offering a complete kit with circuit boards soon.

For more information, contact Ken Vallelonga Sr. at Callsaver Corp., 931 W. Main St., Bridgeport, WV 26330; 304-842-2472, fax 304-842-8890, email: callsaver@iolinc.net.

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News Bytes

ONLINE PHOTO SERVICE MAKES IT SIMPLE AND CONVENIENT TO TAKE AND GIVE PICTURES

You've got your digital camera finally. Great! You've got your digital photos now. Great! Now what?? **Shutterfly** – the leading provider of online photo services for digital and film cameras – offers a full range of photography services, including high quality prints from digital and film cameras, enlargements, photo enhancements, personalized messages, and online sharing.

Recently updated features at their web site include:

Personalized photo greeting cards
Send custom photo greeting cards, announcements, or invitations.

Online photo albums
Shutterfly will organize your pictures for you, so you can find them quickly and easily.

Frame your photos
You can frame your pictures and preview them online.

Shutterfly Projects
Shutterfly will provide all the tips you need to create photo calendars, holiday docrations, photo gift tags, and more. There is also a monthly reminder calendar to help keep you informed about holidays and special activities.

Share your pictures
Showcase your photos in a private online gallery for family and friends.

Picture Upload plug-in
The Picture Upload feature transfers your pictures much faster, has an auto-add option, and more information about the progress of each picture you have sent.

New 'Learn more' section
Shutterfly can help you use and improve your pictures. If you are interested in their services, but are unsure how to get started, this part of their site will tell you what you need to know.

To find out more about this innovative service, check them out at http://www.shutterfly.com.

•

INTERACTIVE DIGRADIO "LEARNS" YOUR PREFERENCES TO DELIVER CUSTOMIZED CONTENT

Internet appliance developer DigMedia has announced DigRadio, a stand-alone Internet device that combines a conventional AM/FM stereo receiver with an advanced web-based radio tuner and MP3 playback capabilities. Based on Windows CE 3.0, DigRadio connects to the Internet through a built-in Ethernet connector (for broadband cable) or from its on-board 56K modem.

"DigRadio is more a home stereo component than a computer peripheral device," says Pedro Vargas, a former 12-year business development veteran with Intel and current Chairman and CTO of DigMedia. "DigRadio is the ultimate audio entertainment appliance, designed to learn your preferences to deliver the best worldwide audio content available, 24/7."

"DigMedia's DigRadio is a great example of a cutting-edge Windows CE-based Internet appliance coming to market today," said Keith White, Director of Marketing for the Embedded and Appliance Platforms Group at Microsoft Corp. "By taking advantage of the rich browsing capabilities and comprehensive toolset included in Windows CE 3.0, DigMedia was able to quickly and easily bring to market a powerful Internet radio that allows the consumer to personalize their listening experiences."

Powering the new DigRadio will be Intel Corporation's StrongARMT SA-1110 processor. "DigRadio represents an emerging market of home online appliances based on the Intel StrongARM processor," said Mark Casey, Director of Marketing for the Handheld Computing Division at Intel Corp. "StrongARM – and the upcoming Intel XScaleTM processor architecture – provides a powerful combination of performance and cost benefits that home online appliances, next generation smart cell phones, and wireless personal digital assistants can leverage, creating a common platform for users to get the most out of their devices."

DigRadio features eight physical radio station preset buttons and a four-axis navigation wheel. Unlike many Internet appliances, DigRadio simplifies web browsing with a large color graphic display and remote control for ease of programming. Additional features are controlled from a personal web site called MyDigRadio. An interactive service, MyDigRadio is used to search out new worldwide audio content based on user preferences, genre, or region. Personal music and radio station preferences can be stored in any of seven user profiles to share music content with friends and family.

MyDigRadio eliminates the need for local storage with a unique web-based service that stores WMA, MP3, and other audio file formats into a digital locker, ready for instant streaming playback on the DigRadio. MyDigRadio is among the first Internet virtual drives created specifically for the storage of sound files, and the only interactive service of its kind to incorporate Digital Rights Management (DRM) in a streaming environment.

About DigMedia, Inc.

DigMedia, Inc. is an end-to-end, digital media distribution company and manufacturer of Internet audio appliances providing secure streaming media, hosting and e-business services to record labels and other music content providers. DigMedia strategic allies include; Intel (Web hosting, streaming media) and Intertrust (Digital Rights Management). DigMedia, Inc., is based in San Diego, CA with offices in Edinburgh, Scotland. For more information about DigMedia, Inc., visit the company's Web site at http://www.digmedia.cc.

Continued on page 75

ELECTRONICS Q & A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware, software, circuits, electronic theory, troubleshooting, and anything else of interest to the hobbyist.

Feel free to participate with your questions, as well as comments and suggestions.

You can reach me at:

TJBYERS@aol.com

or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 92879.

What's Up:

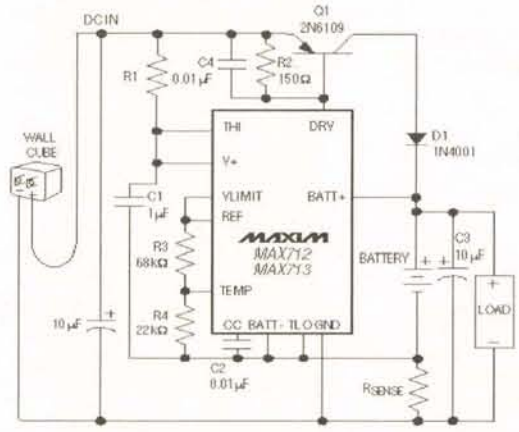
Chatty headlights-on reminder, voice-less doorbell chime, and how to interpret schematic pinouts. Plenty of charts and tables, directing you to web sites, dealers, and books. And finally, a look at rechargeable batteries and chargers, with a rechargeable substitute for the ubiquitous CR123A lithium camera battery.

Universal NiCd and NiMH Battery Charger

Q. Could you give me a battery charging circuit applicable to one, two, three, four, or more NiCd or NiMH cells (1.2V, 2.4V, 3.6V, etc.)?

Dave Bunting
via Internet

A. I can give you the circuit you ask for, plus a choice of charging methods using the MAX712 and MAX713 from Maxim **(www.maxim-ic.com)**. Either IC can fast charge from 1 to 16 NiCd or NiMH cells at rates up to 4C (four times the discharge rate). The difference is that the MAX712 terminates fast charge, dropping to a trickle charge, by detecting zero voltage slope, whereas the MAX713 terminates fast charge using a negative voltage-slope detection scheme. Either chip can be used in a linear or switch mode configuration. While the design is too complex to fully discuss in the room I have, the basic linear mode looks like this.



The values of R1 and RSENSE are determined by the charge rate and can be found on charts provided in the MAX712/MAX713 datasheet (http://pdfserv.maxim-ic.com/arpdf/1666.pdf).

Need More On MAX713 NiCd Battery Charger

Q. Just finished reading about the NiCd battery charger in the Sep. 2000 issue (page 14).

I would like to build this circuit very much to charge my AA NiCds that I use in my digital camera. Would you please answer a few questions that I have concerning this project?

1) Where can I buy the parts in small quantities, and is a kit available?

2) Could you go into more detail as to the input voltage, other than being 6-12 volts? Can it be half-wave rectified, say out of a couple of diodes from a 12-volt transformer, or does it need to be well-filtered DC? And what about current requirements?

Any help you might give will be greatly appreciated.

Bill Ross
via Internet

A. The circuit shown in the Sep. 2000 column is a specific application of the generic circuit design above ("Universal NiCd and NiMH Battery Charger"). Your best bet is to obtain the datasheet and cross reference your voltage and current needs to the resistance values from the charts provided. Now, on to the questions. All the parts are available from **Digi-Key (800-344-4539: www.digikey.com)**; the Maxim chips sell for about $7.00 each. An evaluation kit is available from **Maxim (www.maxim-ic.com)** itself. They are MAX712EVKIT for linear charge mode and MAX713SWEVKIT for switching charge mode.

As for input voltage, the MAX712 and MAX713 are very tolerant of the voltage input. The only requirement is that the input voltage be 1.5 volts greater than the charging voltage; it doesn't have to be regulated. But I suggest that you reduce the ripple as much as practical. Current requirement? Check out the datasheet charts on page 2 of the datasheet.

... And More Manual Dealers

Q. I'm hoping either you or your readers can help me out. I am trying to restore two old radios and looking for schematics since they appear to have parts missing, or at the very least modified over the years.

One is a Hallicrafters S-41 W which appears to be a short-wave receiver, and the other is a Lafayette HE-35 crystal-controlled six meter transceiver. It appears to have only a single crystal socket on the front panel and is very primitive by today's standards. Both radios use tubes.

Gary De
via Internet

A. Several people sell schematics and/or manuals for these two radios. My choice is Hi-Manuals at **http://www.hi-manuals.com** — but they aren't the only one. In fact, since I updated my list of schematic sellers last Oct. I, had an influx of responses from readers who add their favorite to the list. I don't have space to list them all, but I do want to show a couple of the more interesting ones. The complete list can be found at our web site **(http://www.nutsvolts.com)** under the name MANUALS.TXT.

PC Monitors
M-HOUSE Editrice
+39 02 2570447
http://www.m-house.net/esubindex3.htm

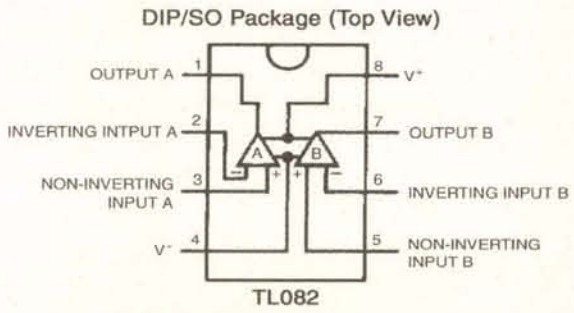
Ham Related
W7FG Vintage Manuals
402731 West 2155 Dr.
Bartlesville, OK 74006
(918) 333-3754
http://www.w7fg.com

When To List Pinout, and When Not

Q. I want to build the high-pass filter, that you described in the Nov. 2000 issue, to remove all audio signals below 100 Hz. I went to my local electronics store and they sold me an eight-pin IC for the TL082 you recommended. However, your diagram shows only five pins. Did I get the wrong chip from them? Also, could you indicate the pinout numbers for me so that I can build the circuit?

Chet WB2AHK
via Internet

A. To begin with, the TL082 is a dual op amp, only one of which is used in the high-pass filter. This may be a part of your confusion.



TL082

I purposely don't show the pinouts of the op amps

or logic chips because that would lock you into a specific chip when any number of generic chips will work in its place. Suitable op amp substitutes for the high-pass filter circuit are TL081, LM741, LF347, LF353, LM358 ... and so on. When I specify application specific chips, like the LM3914 Dot/Bar Display Driver, I provide the pinout numbers.

TV Repair Links ...

Q. I have a 10-year-old 27" TV with a horizontal problem. When there are bright (especially white) areas on the right side of the screen, the entire scan lines corresponding to the bright area are shifted to the left. When venetian blinds are displayed it looks very wavy. Any thoughts on the cause?

Greg Morris
via Internet

A. I receive requests like this all the time, but I'm sorry to say they are outside the scope of this column. Most TV service problems are model specific, so for me to cover the subject properly I'd have to devote the column to nothing but. (The last time I did TV repair was last year, this time, in Trinidad during Carnival for a shop owner named Charlo, where most of the repairs consisted of ridding the chassis of roaches to restore the HV.) Fortunately, there are several professionals on the web who are willing to share their knowledge and experiences. I carefully combed the web for those that meet the needs of our readers. They are listed below, and also posted on our web site under the name TVREPAIR.TXT.

TV Repair Tips
Ana Tek Corp
www.anatekcorp.com/faq/tv.htm

Curt's TV
www.geocities.com/WallStreet/Bureau/7507/repairtip.htm

Electronic Repair
http://elmswood.guernsey.net

Joe's Tech Support
http://balancedliving.to/tech/tv_repair.htm

Repair World
www.repairworld.com/# ($8.00/mo)

Sci.Electronics.Repair (S.E.R) FAQ
www.bithose.com/serfaq/REPAIR/F_tvfaq.html

ShopHelper
www.shophelper.net ($15.99/mo)

T.V. Tech Tips
http://homestead.com/tvtechtips/home~ns4.html

Original Parts Sources
Electronix Corp
One Herald Square
Fairborn, OH 45324
(937) 878-9878
www.electronix.com/

Tritronics, Inc.
1306 Continental Drive
Abingdon, MD 21009-2334
(800) 638-3328
www.tritronicsinc.com

Tritronics, Inc.
1952 NW 93rd Ave
Miami, FL 33172-2925
(800) 365-8030
www.tritronicsinc.com
Se Habla Español

Schematics
Sams Photofact
www.samswebsite.com/photofacts.html

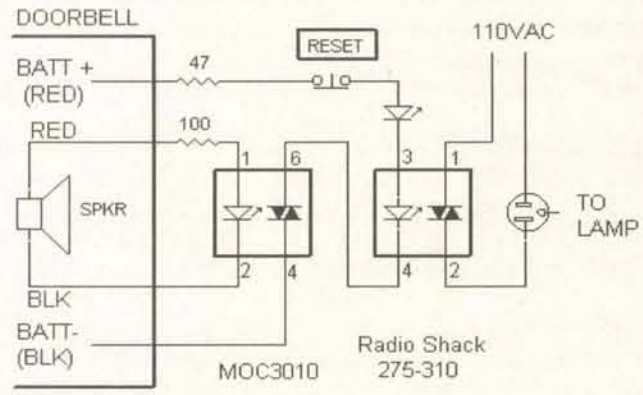
TV Tech (10.95/schematic)
www.tvtechplus.com/

Doorbell Lamp

Q. I would like to add an LED, a latching-type relay, and a reset switch to a battery-powered (three C cells) Trine #510 wireless door chime. When the chime is initiated, the LED would light and close the relay contacts, which would turn on a table lamp. This will enable a hard-of-hearing person to recognize that there's someone at the door. The reset switch would turn off the LED indicator and unlatch the relay, and turn off the lamp until the next chime.

Bob Shaffer
via Internet

A. This is something that has been done over and again — mostly for indicating when a phone rings. Normally, I'd point you in the direction of a RadioShack product, but you've added a new element to the formula by inserting a wireless doorbell. Consequently, you need a latching relay, as you indicate. I must commend you on your insight into the problem, now let me see if I can finish off what you started.



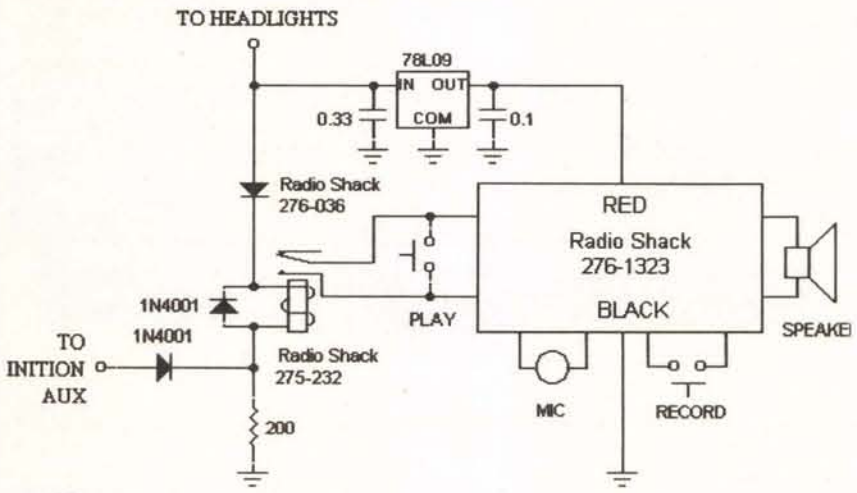
The circuit is divided into parts. The first part is the chime detector and LED indicator. When the doorbell is pressed, it generates a three-volt signal across the chime's speaker. We use this voltage to turn on an LED inside the MOC3010 optoisolato, which, in turn, turns on its related triac. Once the triac is triggered, it remains conduction even if the speaker voltage disappears. In series with the LED is the "coil" of a solid-state relay (RadioShack 275-310), which lights the table lamp. This condition will exist until the RESET switch is pressed, which breaks the current flow to the MOC3010 triac and extinguishes it. The Alarm is now armed and ready for the next visitor.

Talking Headlights-On Reminder

Q. Your lights-on reminder in the August 2000 issue was just what I needed, and works perfectly in my Toyota. After using it, it reminded me that I once had a 1984 Nissan Maxima that would remind motorists with a voice — "lights are on, lights are on" — instead of a buzzer. Can you suggest a way to do this, cheap and simple like your buzzer reminder?

Vic Mukai
Alexandria, VA

A - All you need to do is add a voice chip to the original design. I suggest RadioShack's prewired digital voice recording and playback kit, 276-1323. This kit stores and plays back up to 20 seconds of voice, music, sound effects — or any mixture of audio sounds you wish — and comes complete with switches, speaker, battery snap, and microphone. To record your message, press RECORD and talk into the microphone. To play it back, press PLAY. Each time PLAY is pressed, the message is repeated.



Of course, you have to replace the buzzer with a relay if you want the headlight-on sensor to start the PLAY sequence automatically. There is one slight catch, though. Holding down the play button doesn't repeat the message; only one playback per punch, no matter how long you hold the PLAY button down. So I placed a flasher LED in series with the relay to pulse the relay on and off. When the LED is on, current flows through the relay and closes the contacts, thereby "pushing" the START button. When the LED turns off, the relay drops out. As long as the headlights-on condition exists, the sound board will continue to squawk your message. As a bonus, you can mount the LED in the dash for a flashing visual warning. However, the supplied speaker leaves something to be desired, in both quality and loudness. This is easily remedied by replacing the original speaker with a standard eight-ohm speaker, like those found in PCs.

DVD Video Defined

Q - Do you know the exact definition of the Y, Pr, and Pb signals that are sent by a DVD player? I have a video monitor capable of handling RGB at NTSC rates (Mitsubishi Diamond Scan) and I was wondering if it's possible (I mean easy; it's always possible) to build a component to RGB converter.

Don Venhaus
via Internet

A - The following answer is an excerpt from Jim Taylor's excellent article "DVD FAQ," located at http://dvddemystified.com/dvdfaq.html.

Most DVD players have the following video output connections, which can carry an NTSC, PAL, or SECAM signal.

- **Composite video** (CVBS). Standard yellow RCA video plug. Combines all three video signals into one.
- **S-video** (Y/C). four-pin round plug. Separates brightness signal (Y) from two color signals (C).
- European players combine both of these signals, and others, into a 21-pin rectangular **SCART** connector.

Some players may have additional video connections:

- **Component interlaced** analog video. Keeps all three video signals separate.
  - **Y'PbPr format:** three RCA or BNC connectors.
  - **RGB format:** SCART connector or three RCA or BNC connectors.
- **Component progressive** analog video. Keeps all three video signals separate.
  - **Y'PbPr format:** three RCA connectors.
  - **RGB format:** SCART connector or three RCA or BNC connectors.
- **RF video:** For connecting the TV antenna input on channel 3 or 4.
- **Screw-on F-type connector:** May require an adapter.

Most of the DVD players with component video outputs use YUV (Y'PbPr), which is incompatible with RGB equipment. European players with SCART connectors have RGB outputs. YUV to RGB transcoders are rumored to be available for $200-$300, but seem hard to track down. A $700.00 converter is available from **avscience**, and a $900.00 converter, the CVC 100, is available from **Extron**. Converters are also available from **Altinex, Kramer, Monster Cable**, and others. For progressive scan you need a converter that can handle 31.5 kHz signals. Converters from s-video are also an option **(Markertek Video Supply, 800-522-2025)**.

Note: The correct term for analog color-difference output is Y'Pb'Pr', not Y'Cb'Cr' (which is digital, not analog). To simplify things, this FAQ uses the term YUV in the generic sense to refer to analog color difference signals.

No consumer DVD players have yet been announced with digital video outputs, but digital output will soon be available using FireWire (IEEE 1394) connectors. There are specialty players from **Function Communications** with SDI (serial digital interface) output, but this only connects to high-end production equipment.

Forget Your Password?

Q - A friend gave me a 486 DX2 Packard Bell computer. The computer has Windows 95 Plus! installed. However, my friend does not remember the passwords to unlock certain parts of the Windows functions. How can I found out what these passwords are?

Broderick Hall
Ft. Myers, FL

A - There's no reason to try to locate the old passwords. It's easy enough to erase them and start all over with your own passwords, if you wish — but you don't need passwords to operate Windows 95. Boot the PC in the DOS mode, using a bootable floppy, and erase the password files using the following commands.

```
CD C:\WINDOWS
DEL *.PWL
```

Remove the boot diskette and reboot the system. You now have access to all parts of Windows.

For those readers who have problems booting the PC itself because of a forgotten password, I've compiled a list of passwords that sometimes work (the passwords in this list ARE case-sensitive). You can also find this list on our web site under the name PASSWORD.TXT, and I'd appreciate any additions or comments you may have. If all else fails, removing the EEPROM battery

almost always resets hardware (not software) passwords. Remove the battery, go eat lunch, replace the battery, and power up. The problem is that some EEPROM batteries nowadays are soldered onto the motherboard.

These passwords sometimes work if the user-set password is forgotten; they ARE case-sensitive.

AWARD BIOS	589721	ZBAAACA	Misc.
AWARD SW	595595	ZAAADA	LKWPETER
AWARD_SW	598598	ZJAAADC	lkwpeter
Award SW	HLT	djonet	BIOSTAR
AWARD PW	SER		biostar
_award	SKY_FOX	AMI BIOS	BIOSSTAR
awkward	aLLy	AMI	biosstar
J64	aLLY	A.M.I.	ALFAROME
j256	Condo	AMI SW	Syxz
j262	CONCAT	AMI_SW	Wodj
j332	TTPTHA	BIOS	
j322	aPAf	PASSWORD	
01322222	HLT	HEWITT RAND	
589589	KDD	Oder	

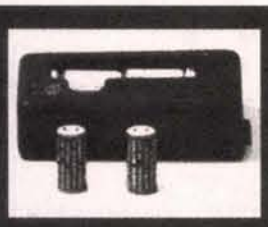
Rechargeable CR123A Battery

Q - I am looking for a rechargeable replacement for a single CR123A lithium photo battery. The solution must be physically compatible with the CR123A.

Loren Setzer
Lenoir, NC

A - You and about a million other people who spend $6.00 to $9.00 per battery that lasts, at the most, 100 flashes — about three rolls of film. Strangely enough, only one company thinks this is a lucrative enough market to provide an alternative:

Quest
Broad Street
Whittlesey, Peterborough
PE7 1HA, United Kingdom
441733 204600
www.2cr5.co.uk/acatalog/Online_Shopping_Rechargeable_CR123A_Batteries_and_Chargers_2.html



CR123A Charger

This powerful charger, specially designed for Quest's unique rechargeable CR123A batteries, offers an intelligent charging process providing a 5 year life to the battery. The charger can be powered from the mains, from a car/boat cigarette lighter socket (see "Car Adapter" below), or from anywhere else using the optional Field Power Pack (see "Portable Power Packs" section). Safety features include automatic inhibit on attempts to charge ordinary lithium batteries and protection from short circuits, reverse battery connection, and overheating.

Rechargeable CR123A Batteries (2 pack)

This unique, rechargeable Nickel Metal Hydride battery is an economical alternative to the disposable lithium CR123A. Only available from Quest and Quest's distributors, this battery offers a life of 5 years against the one-time use of its disposable counterpart.

Note: for use only with purpose-designed, intelligent charger (see above).

MIDI Primer

Q - The MIDI article in the Oct. 2000 issue interested me in doing more things with MIDI. So my request is to get a more in-depth explanation of the MIDI encoding and decoding than was in the "Xylotron" article side bar. Any articles or books that provide the information would probably be enough, because I can figure out the voltage level, and I assume the clock rate is 31.250KHz (is this correct; what is the tolerance?). What I really need is the format (bit weight) and wave shape of the MIDI Status Byte, and wave shape of the MIDI Data Bytes. What determines how many Data Bytes follow a Status Byte? Finally, is there more than one MIDI standard in use today?

Joseph Ennis
Valparaiso, FL

Cool Web Sites

Want to call your family or friends in Fargo for free? Using the Internet it's done every minute of everyday. Steve Bass has details.
www.sciam.com/featureart/featarch00.html

RS-232 defined!
www.arcelect.com/rs232.htm

Like to dream in 3D? Fantasize about being Santa Clause? Ever wanted to build your own toys? Help yourself using the services of ToyBuilders. They turn imagination into reality!

www.toybuilders.com/

A - Boy, that's a mouthful! I suggest you start off carefully with no preconceived assumptions and proceed slowly. Otherwise, you'll be very disappointed with the end results. The book I recommend is *Basic MIDI* edited by Paul White (ISBN: 1860742629). Amazon.com sells it for $8.95. While you're waiting for your book to arrive, check out these web sites.

www.harmony-central.com/MIDI/Doc/tutorial.html
www.borg.com/~jglatt/tech/miditech.htm

Fuzzball Says "Fix That PC PS"

Q - Some years ago, I tried to find a circuit diagram for a standard computer power supply so that I could try to repair it. I simply could not find one (except for a guy in Arizona, who offered to sell me one for $40.00). Now that power supplies are so inexpensive it would be a waste of time trying to repair one. Or is it?

W. Brown
via Internet

A - No, it's still feasible and cost effective. I wrote an article on "PC Power Supply Repair" a few years ago that has been "reprinted" on our web site at **www.nutsvolts.com/PDF_Files/PSRepair.pdf**. In fact, if you haven't checked lately, our web site has had a complete make-over. In addition to a search engine that locates past articles and subjects, there's "Fuzzball" and the New On-Line Store. Check it out! **www.nutsvolts.com**.

MAILBAG

Dear TJ:

Further to Bill Stiles' kind note in your Dec. 2000 issue about our Black Magic Telephone Ringing Generator, I am pleased to advise that your readers may freely download from our new website at **http://www.camblab.com** to obtain our engineering design guide "Telecom Design Tricks" and our hobbyist manual "Old Telephones: How To Repair And Rebuild Them." We also have datasheets on a number of ringing generators (with different input voltages and output powers) beyond what is offered in the Jameco catalog.

Jeffrey Race
Cambridge Electronics Laboratories

Hi TJ:

I read with interest your reply to P. J. Hicks in the Nov., 2000 issue, "Time Is On My Side," that describes a garage door closer. Your answer was perhaps workable. But I've shipped up a solution of my own that I've been using reliably for years. You can see it at **www.io.com/~jeffja/projects.htm#garage**.

Would you be so kind as to pass that along to P. J. Hicks? I'd be glad to share the details.

Jeff Jones
via Internet

Response:

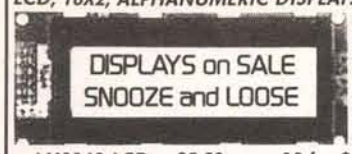
I asked Jeff if he would like to share his project with all our readers by placing it in an article. He agreed and is working on it now.

TJ Byers
Q & A Editor

CORRECTION

A typo occurred on page 41 of the Jan. 2001 issue. The correct answer for the Windows Explorer keyboard shortcut is WinKey+E. — TJB

LCD, 16X2, ALPHANUMERIC DISPLAYS,



Brand New, Solomon, the LM1140-SYLU, with LED backlight. Std. 16 x 2 arrangement of 5 x 7 dot matrix characters 2.95mmW x 5.56mmH with cursor. COB driver with 8 bit parallel interface. Module size: 85mmW x 36mmH, Viewing area: 63.5mmW x 15.8mm H. with data.

LM1140-LCD.....$5.50ea. or 10 for $4.00ea. or 100 for $3.50ea.

INFRARED, THROUGH BEAM SENSOR with 0.3mm RESOLUTION! STM, Model V6BP amplifier with DLV-60 Sensors.

This super IR position sensing system is extremely sensitive and highly accurate. Capable of operating at distances up to 1000mm (39") while detecting objects as small as 0.3mm (0.01") at up to a 500Hz rate. The mini sized (6mm x 6mm x 12mm) sensors use an 880nm IR LED for invisible operation. The remote amplifier module, Size: approx. 1.3"W x 2"L 0.6"D, includes three LED indicators for VDC, SIGNAL capture and ALARM. There is also a front panel sensitivity adjustment as well as a Dark on or dark off setting. The output is PNP. The system can be powered by 10-30VDC @60mA. Units are removed from new equipment and guaranteed. With data.

LTD. QTY. **NEW YEARS SPECIAL, STM-V6BP.....$24.00ea. or 2 for $39**

10V @ 2.5 AH SEALED, LEAD ACID, PACK.

Each pack has 5, 2 Volt cells. "D'size cells are arrainged as 1X5 cells. Enclosed in an ABS outer shell. (removed for photo) Perfect for high drain applications. Make custom packs of any rating. Size: 7.5"L x 2.8"H x 1.5"D **SALE! 6-five packs for $20, 40 for $99**

ULTRA MINI, PINHOLE LIPSTICK CAMERA"

Sleek black anodized, alum. housing. So tiny you can install it directly into a door. Only a 0.9" diameter hole! 90° FOV Pinhole lens, a real glass lens, 1/2 once! Size only 23mm d.x35mm long. Think of the places you could put this little jewel. Adj. tilting mount. 1/3" CCD, 380 Lines, 0.3 Lux, AGC, Auto Shutter. 9-12VDC @100mA, NTSC video. <1ounce! IR SENSITIVE., 36" cable with BNC video & DC barrel jack.

SPECIAL, GM-200KPH....$59ea.
Power adapter.....$4.95ea.

WORLDS SMALLEST••100mW••VIDEO TRANSMITTER,

Incredibly only 0.9" x 0.8" x 0.37" Transmits crystal controlled hi-res. images with 100mW output! The transmitter you've been waiting for. Shown actual size. Much smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned. Receive on cable channel 59. Will work with color or B&W cameras. UHF Bow tie antenna with balun and 3' F cable for TV Included. Perfect with our GM1000A.

TVX-100.....$159 TVX100 & GM1000A CAMERA.....$209

MAXON, DC GEAR MOTOR, type 41.022.022-00.00-268, Super Efficient, Swiss Precision, High Torque.

These are brand new, super high quality, miniature gearmotors. So precise they will start to turn at less than 1 Volt.They offer a 3mm diam. x 9mm long, flatted output shaft, located on-center of the 22mm diam 19.2:1 ratio, 2 stage, 0.2Nm max, planetary gearbox. Overall size: 22mm d x 63 mm L (including the shaft) with solder tabs at the rear. The motors provide the following speeds:

@VIN	I NO LOAD	RPM
6V	11mA	135
9V	13mA	207
12V	16mA	276

FEBUARY Special, Limited Quantity, MAXOX-22.....$22ea. or 5 for $99

low cost MICRO CAMERAS, w/audio 1/3"

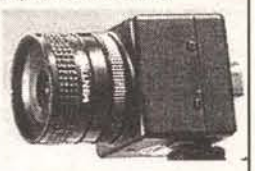
CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Pwr. from 9 to 12VDC @100mA, 250k PIXELS, Std. model, 4mm, 78° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 ounce! SENSITIVE to IR. Size Std: 1.25"sq. x 1"d. PH is 0.6"d, 1.6M long wiring harness with connectors included. WARNING: Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS.

GM-1000A-STD.....$59 GM-1000A-STD/Aud.....$64
GM-1000A-PH.....$59 GM-1000A-PH/Aud.....$64

Micro Lenses for GM1000 series

2.5mm, 150°.....$22	8.0mm, f2.0.....$22
4.3mm, 78° f1.8.....$22	12.0mm, f2.0.....$22
6.0mm, f2.0.....$22	5mm, 70°PH.....$22

SUPER, MINI C-MOUNT CAMERA, with FREE LENS



The Super Sensitive, GM410 Specs: size only 1.5" SQ. x 1.6"L, 410 Lines Res., Sens. 0.05 LUX., 1/3" CCD with AGC & Electronic shutter. 12V @110mA power. NTSC out. IR SENSITIVE, BNC video out, Std. DC pwr. jack. Aluminum housing with dual threaded top and bottom mounting. True performance not hype! This cameras will outperform *ANY* camera in this magazine. Multi- lens options are available to exploit the superior performance. Your choice of a standard lens, FREE! 4mm or 8mm or 12mm. **GM410, with FREE LENS special....$169ea.**

C-MOUNT LENSES

LOW LIGHT	STANDARD
16mm, f1.6, 15° FOV $39	4mm, 80° FOV $24
8mm, f1.3, 40° FOV $49	8mm, 40° FOV $24
4mm, f1.4, 78° FOV $49	12mm, 28° FOV $24

CO2, 30Watt CW, SEALED GLASS LASER HEADS Integral Hard Sealed Mirrors, NEW!

High quality water cooled heads. Were originally designed for medical application. Model 135: 35"L x 3.2"diam. Power requirement, 25KV trigger with 15-20KV @ 7 to 25mA operating current. These are not toys. They must conform to Class IV CDRH regulations when assembled into a functioning system. Includes state of the art, compact switching power supply. Perfect for engraving, cutting and drilling. Only two available.

New Tube and Power Supply. **Limited Qty. 35Watt CO2 Package.....$995.**

SUPER SPECIAL OFFER,

Articulated beam delivery arm with focusing hand piece. Brand new. A fantastic item. Regular price >$3500.ea! With purchase of tube above ..$595ea.

INCREMENTAL, OPTICAL ENCODER provides 120 ppr.

Motion Control Devices type C-0102, 5VDC powered. TTL compatible output, Chan. A and B, 1/4"diam. x 1"L, ball bearing shaft. Size: 2.75"diam x 1.9"deep Brand new. Photo right with square mntg. flange.

FEBUARY Special.....$35ea. or 2 for $69

NEW, "PELTIER" THERMO ELECTRIC MODULES, TECA type 960-127, Single Stage

Brand New, solid state thermoelectric modules. Silent, compact & reliable. Thermoelectrics require no maintenance & can heat by reversing the input. No load cooling to - 42°F with the hot side at 77°F. No vibration or noise operates in any orientation. Specs.: Max^T=66°C @ 27°C, Max current, 3 Amps, Max voltage, 15.4V. Size: 1.18" L x 1.18"W x 0.142"H **SPECIAL.....$8ea. or 4 for $29**

LAST TWO UNITS AT A SPECIAL PRICE! Save $35K+ FABULOUS, NEW, YAG LASER SYSTEMS PROVIDES, 100Watts, CW @1.064um, also a frequency doubled model with 60Watts or GREEN @ .532um

Laser Photonics Type: YCO-1003M, adjustable output power from 100mW to 100Watts ± 2%. Modes include: CW, Single pulse adjustable from 0.1 to 9.9 seconds in 0.1 sec increments. Repeat pulse with adjustable duration as previous and adjutable rate from 0.1 to 9.9 seconds in 0.1 sec. increments. Beam delivery via a 4 meter length quartz fiber optic. Internal fiber calibration system. LCD control panel for easy setup. Frequently used program settings can be saved to memory. Internal graphics printer. Pulsed laser diode aiming laser. Two stage microprocessor system monitoring. Key switch access with foot switch laser activation. Internal liquid to air cooling. Power required: 220VAC, single phase @40A, 60Hz. Mechanical: 38"H x 33"W x 22"D, weighs 325lbs., Wheel around cabinet. The Dual mode system in addition to the YAG specifications above includes frequency doubling an demand. The green output is Q-switched at 10KHz producing an output beam of 6mJ @ 200ns or 60W average with 2 to 40 watts delivered at the fiber. Pulse mode operation for the dual mode is different as well: Single pulse mode is adjustable from 0.1 to 600 seconds in 0.1 sec. increments. Repeat pulse mode has the same adj. pulse width and an adjustable pulse interval of 0.1 to 9.9 seconds in 0.1 sec. increments. These numbers apply to the 1.064 wavelength only. Cabinet size: 40"H x 33"W x 23"D weight 500lbs. Both models are NEW. Must ship via truck.

NEW, 100W, 1.064um, CW YAG SYSTEM.....$10K
NEW, DUAL FREQUENCY YAG SYSTEM with 60W GREEN.....$15K

NEW! HELIUM NEON LASER TUBE STEAL of a DEAL DON'T WAIT and be DISSAPPOINTED!

AFFORDABLE, NEW and INDIVIDUALLY BOXED, PERFECT for SCHOOL SCIENCE PROJECTS.

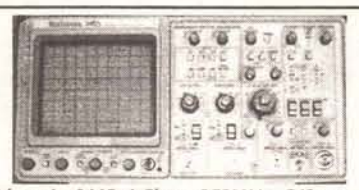
OutputPower Typ.	1.0 mW	Maximum Starting Voltage	10 kV dc
Wavelength	633 nm	Expected Operating Lifetime	15,000 hours
Beam Diameter (TEM_{00})	0.63 mm	Overall Length	9.6 inches
Beam Divergence (TEM_{00})	1.3 mrad	Mounting Diameter	1.0 inches
Operating Voltage (±100)	1000 Vdc	CDRH Class	IIIa
Operating Current (±0.1)	4.1 mA	Note: We do not have power supplies	

UNIPHASE, Hard sealed for long life, 1100 HeNe tube. NEW YEARS SPECIAL.....UNI-1100...$20ea. 6 for $99

SUPER DEAL, RCA, 4 CHANNEL, VIDEO AUTO SWITCHER

Model TC-1404 . Connect up to four standard video signals to the rear panel BNC inputs and they will be sequentially output to a rear panel BNC video output. Front panel has adjustable, variable dwell time from 1 to 15 seconds per channel. LED channel indicators. Four, auto or manual toggle switches with channel bypass. Mini size only 4.2"W x 7.8"D x 1.2" H, ac powered. Video loop through. Direct 110VAC power. Used.

Special, TC-1404 Video Switcher....$49ea. 2 for $89



Tektronix, 2445, 4 Chan., 150MHz, O'Scope, with on screen waveform stats,

One of the most popular & powerful scopes available at a reasonable cost. Features: 500ps/Div sweep, 2mV/Div. vertical sensitivity, 1Mohm / 50-ohm input, 500Mhz trigger bandwidth, four channels. On-screen waveform cursors provide vert. & horiz. scale factors, trigger level, voltage, time, freq., phase, ratio values and mode indication. Complete with 2 probes, and manual. Excellent condition. 90 day warranty.

NOW.....$1295.

Q - SWITCH, by CRYSTAL TECHNOLOGIES,

We were fortunate to obtain a small quantity of these first quality type 5100 units. They were destined for use in a 100W YAG laser. See "YAG LASER above left" No specifications at press time. Water cooled. Matching RF drivers available. Limited quantity.

Q-SWITCH less driver....$225
DRIVER/SWITCH COMBO..QRF100..$550ea.

NEW, "STEALTH CAM", MICRO SIZE, with AUDIO!

The sleek aluminum housing fits like a glove! Removeable mtg. bracket & a 1.3M cable with BNC vid., RCA aud., (internal mic) & DC pwr. jack for, no sweat hook up. Why fool around with an open P.C. board? Now you can have the "STEALTH CAM"•1/3" CCD •410 Lines•0.3 Lux• AGC•Auto Shutter• Pwr. 12V @110mA•250k pixels•Std. 4mm, 78° FOV lens•Pinhole, 90° FOV• Focus:10mm to inf.•NTSC video•<ounce!• IR SENSITIVE • Size Std: 30mm sq. x 29mm d. PH: 16mm d. Don't confuse with LOW RES., HIGH LUX C-MOS CAMERAS

GM-2000S-STANDARD OR PINHOLE,
with audio, FEBRUARY SPECIAL...$69ea.

PORTABLE MINI PRINTER, 40 COLUMN, with INTERNAL NI-CAD POWER!

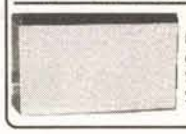
The model SD222-1000 is a NEW & very cool, self contained, alphanumeric/graphic, impact printer. Standard parallel port, internal Ni-Cad power supply. Can be powered via the 9VDC pwr. adapter supplied. Standard 2" paper and Epson ERC-09 ribbon (included) both available at Staples etc. Has self test & diagnostic mode. Can emulate Epson and Citizen 560. It will print from the LPT port of your PC. Very rugged & well made. Perfect for remote printing or data logging application. Size: 8"L x 4.1"W x 3.5"H. STD. **SPECIAL SALE.....$39ea. or 2 for $69**

DC GEAR MOTOR, BUEHLER PRODUCTS, type 127K01880 ALL METAL CONSTRUCTION, HIGH TORQUE,

These are brand new, very rugged gearmotors. They offer a 5mm diameter x 9mm long, flatted output shaft, located off-center (approximately 10mm from the edge of the 35mm diameter gearbox.) Overall size: 35mm d x 73 mm L (including the shaft) with 2" red and black leads. The motors are rated at 17VDC nominal and provide the following speeds:

@VIN	I NO LOAD	RPM
12V	60mA	360
15V	62mA	457
17V	64mA	523

FEBUARY Special, BUEHLER 127K.....$10ea. or 3 for $25



6V@12AH SEALED, RECHARGEABLE,

New, Panasonic, LCR6V12PI. Tough to get at a discount. Very compact. Two top mounted 1/4" faston connectors. Perfect for high drain projects. Size: 5.9"L x 3.7"H x 1.9"D

2 for $20, or 10 for $89

BIO-LUMINESCENCE ANALYSIS SYSTEM, An OPTICAL EXPERIMENTERS BONANZA

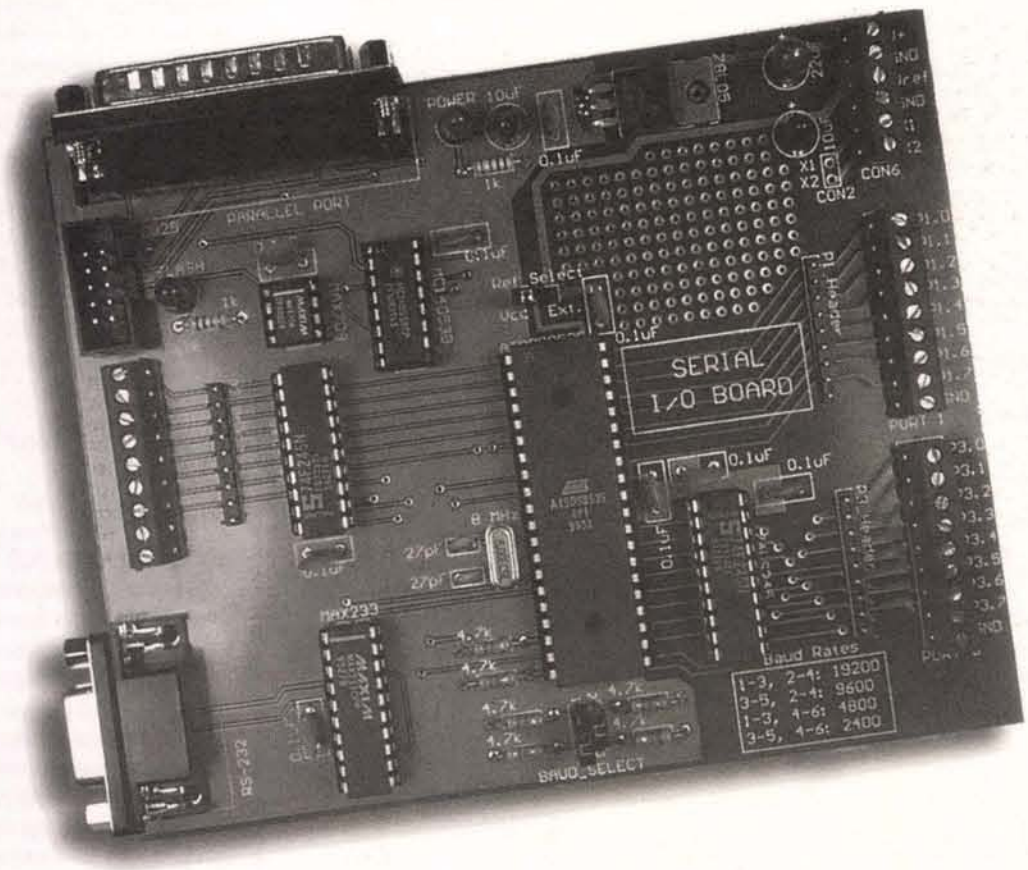
An advanced photon counting system with state of the art electronics including a Hamamatsu, R647 PMT sensor. with solid state power supply, A Varitronix type, MGLS12864T-G-HT-HV, 128 x 64 Graphic LCD display, a Micro thermal printer and a 80C320 micro with 581000AP external memory. Essentially a portable data logging system designed to detect photons. We believe it also has an RS-232 port. As well as associated signal processing for the PMT. An unbelievable gadget with big potential. Originally intended to monitor the cleanliness of surfaces in food and beverage plants, supermarkets, restaurants etc. Monitor efficiency of biocides. Detect contamination in water samples in the paper and pulp industry, water treatment industry and other water applications. (Uses std. 2.2" wide paper rolls) Power required: external 5VDC. System able to use snap in, NICAD pack not supplied. Size: 6.25"W x 8.25"H x 4.4"D. Units are used. Guaranteed to power up and initialize only. We cannot warrant their biological performance. **HOLIDAY SPECIAL.....$69EA.**

A COOL COLOR CAMERA, "The ROVING EYE CAM" with Ultra Compact, 12X ZOOM, PAN and TILT, AUTO IRIS and AUTO FOCUS to boot!

Another super quality color conference camera designed as part of a high end system from PictureTel. The unit consists of a camera head attached to a base PC board. The attachment is via a moveable mount. There are two tiny stepper drives which create the pan and tilt motion. The tilt stepper is mounted to the PC board. The pan stepper is unmounted and attaches to the side on your base or enclosure. We assume the camera is controllable via serial commands however we have no info on how to do it. Anyone who can tell us can have some free cameras. The camera module specs: 400 lines @ 1lux, the power required is 12VDC @ 500mA. size of head is: 5.5" diam. x 3.2"H. The attached PCB is 3W" x 4L" x 1.3"H. Oh, and did we mention it's auto focus and auto iris too? Composite video output. We think it has Y/C also. Check our web site for further details as they become available. Order now, the price goes up when we get the serial commands. Removed and tested. **HOLIDAY PRICE, R2D2....$129ea. or 2 /$249, or 5/$499**

Circle #151 on the Reader Service Card.

Build an RS-232 Serial I/O Board — Part 1



by Ben, Phil, and John Bright

Introduction

Have you ever wanted to use a PC to control a device or read external digital data? Or perhaps you need to read some analog data, such as a temperature sensor. Maybe you want to monitor switch closures and are looking for an alternative to continuous polling.

In this article, we will show you how to build an RS-232 serial I/O board which, when connected to your PC's serial port, will let you do all these things and more. When you have completed this project, this board will provide you with three eight-bit ports of digital I/O, one of which can be optionally configured as a port of eight analog input channels.

This board also features the special ability to notify your software application when an input pin has changed value. In most cases, this special event-based feature of the board eliminates the need for your software applications to continuously poll an input. Finally, we will also provide you with software libraries for both Linux and Windows platforms, allowing you to easily write applications in C, C++, or Visual Basic.

Overview

There are three natural divisions in a project of this nature:

1. First, we will discuss the hardware design of the I/O board. This will give you a chance to acquire the parts and begin building the board as soon as possible. The design itself is fairly simple, with the central component being an Atmel AVR microcontroller.

2. The second topic will be the firmware for the microcontroller. The firmware we have provided handles communication with the PC over the serial port, as well as all the other tasks required to run the I/O board. We will also explain how to download the firmware to the microcontroller.

3. Finally, we will look at writing application software which runs on the PC and communicates with the I/O board. Our software library makes it very easy to use the I/O board in your Visual Basic, C, or C++ applications.

Throughout this article, we will be consistent with the following terms: 'PC' will mean the host computer that the serial I/O board is connected to. 'Software' denotes application code, which runs on the PC. 'Firmware' is the assembly language code, which runs on the Atmel microcontroller. Finally, 'micro' is short for 'microcontroller.'

1. Hardware Circuitry

The I/O board has three eight-bit I/O ports for your use (Ports 1, 2, 3). The ports support both bit-level and byte-level access; in other words, you can address the port as a whole or just toggle an individual bit. Port 1 is special; it can be configured as an eight-bit digital I/O port or as an eight-channel 10-bit A/D converter. Port 2 and Port 3 function only as digital I/O, but they have the advantage of being buffered for protection of the micro and for increased drive capability. This buffering is handled by two 74245 eight-bit bidirectional buffers.

If you use Port 1 in analog mode, a voltage reference must be selected with a jumper on the I/O board. You may choose either an on-board 5V reference or an external reference. Whenever an analog channel is read, the board returns a 10-bit precision number (0-1023) indicating what voltage is present on the I/O pin. The value of zero is returned when zero volts are present, 1023 is returned when the voltage of the voltage reference is present (the maximum readable voltage), and the other values are scaled between these upper and lower limits.

Two jumpers are used to set the baud rate to be used for the serial connection with the host computer. The jumper positions are explained on the printed circuit board silkscreening and on the schematic included in this article. The MAX233 chip is used to convert serial signals between logic levels and RS-232 voltage levels (approximately ± 10V). This chip is really handy, since it needs only a 5V supply.

Atmel Microcontroller

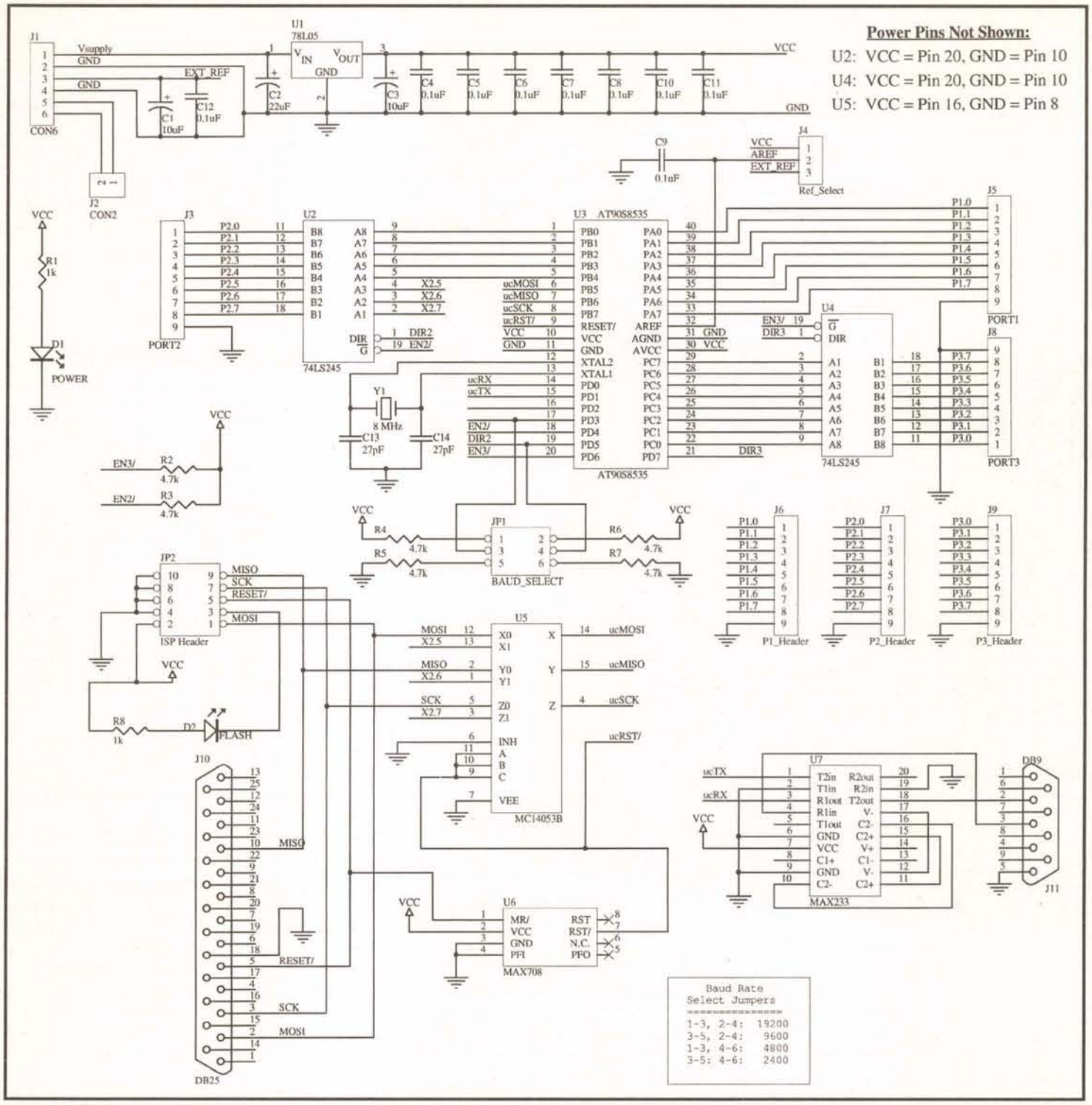
The most prominent component in the circuit is the Atmel AT90S8535. This microcontroller has 8k FLASH memory, 512 bytes SRAM, 512 bytes of EEPROM, and four eight-bit I/O ports (one of which may be configured as an eight-channel A/D converter). In our project, three of its ports are used for the three user-controlled I/O ports (Ports 1, 2, and 3), and the fourth port is used for serial communications and control of the two 74245 buffer chips.

The AT90S8535 is in Atmel's AVR family of microcontrollers. These micros are fast, easy to use, and inexpensive. They use FLASH memory for storage of the program code, so they can readily be erased and programmed without removing the micro from the circuit.

Atmel makes a starter kit — the STK200 — for the AVR line of micros. It includes a development board, software, and a programming cable. It is priced at about $50.00, and it can be used for development and programming for a number of AVR micros. It is not required for this project, but you may find it useful if you would like to further develop this or other projects.

Programming Circuitry

As mentioned above, the AT90S8535 microcontroller can be programmed with new firmware without removing it from the circuit.



Two programming ports have been included on our serial I/O board for this purpose. The 10-pin programming header is for use with the included software and programming cable in Atmel's STK200 starter kit, while the DB25 connector can be used to program the board when connected to a PC's printer port.

When the AT90S8535 is held in reset, three I/O pins on the micro are used for programming. However, during normal operation, these three pins are used for I/O. In order to accommodate both needs, an analog switch IC is used to connect these micro pins to either the programming connectors or the I/O buffer chip for Port 2. Since the micro's reset line is held low during programming and is held high for normal operation, the reset line is used to select the configuration of the analog switch IC.

Please note that the LED that indicates that FLASH programming is taking place is connected to the LED/pin on the 10-pin programming interface, but it is not connected to the DB-25 programming interface. Thus, the FLASH indicator LED will light when the STK200 programmer is used to program the micro, but it will not light when the DB-25 programming interface is used.

Power Monitor

The board also includes a power monitor IC, the MAX708. This chip resets the micro when Vcc drops too low. In particular, this function comes into play during power-up and power-down because it takes a certain amount of time for the power supply voltage to ramp up or ramp down to a valid, steady-state level. The power supply monitor's job is to keep the micro in reset during these transient conditions. Otherwise, the microcontroller's operation is erratic and unpredictable, and the micro may execute any given portion of program code. This is especially troublesome when program code includes a routine that stores data in EEPROM.

Sooner or later, the routine will regrettably be executed during a power-up or power-down condition, and the EEPROM data will be overwritten with garbage.

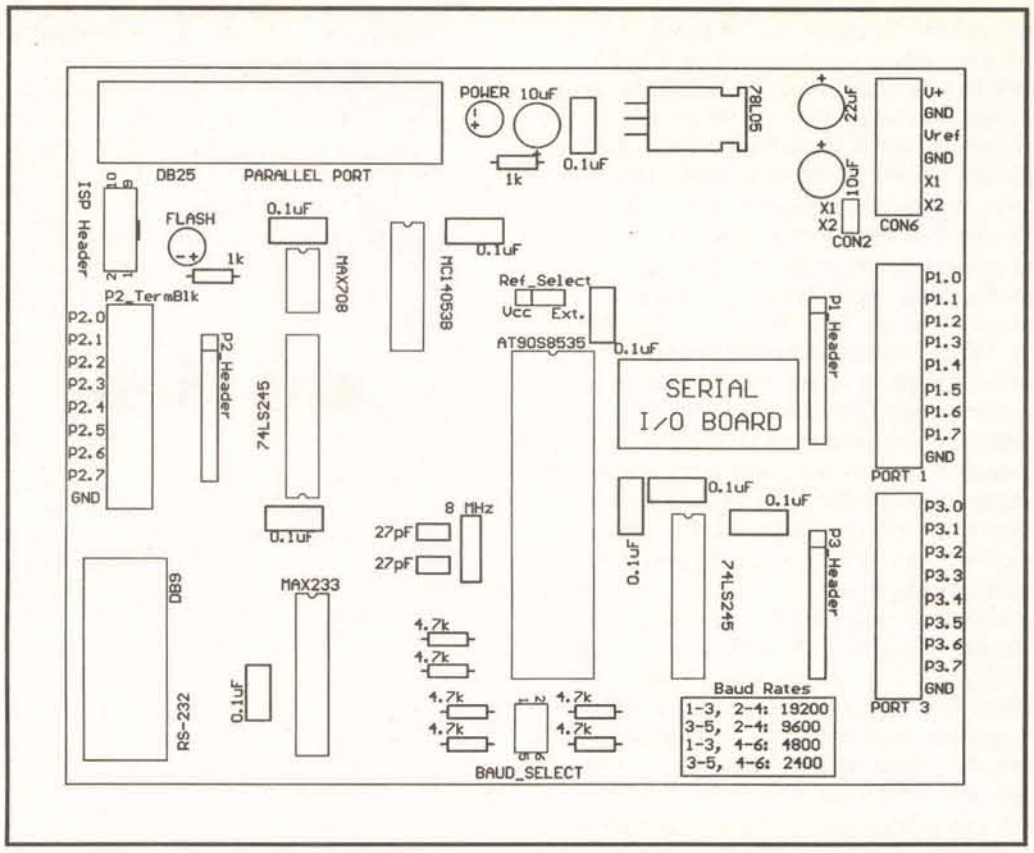
Construction Options/Guidelines

There are several good ways to construct this project. The cleanest and most convenient method is to use a printed circuit board etched for this design. You can make your own by downloading the foil patterns from the *Nuts & Volts* web site at www.nutsvolts.com, or you can order one already made (see sidebar for details).

There really aren't any stringent requirements on layout. Wire-wrap techniques or simple perf board will work just fine. Just be sure to keep the crystal close to the microcontroller, and be sure to include all the filter capacitors shown in the schematic. It is always a good idea to include a filter capacitor near every IC.

II. Firmware

The complete compiled firmware code for this project is included in the accompanying download (see the Resources sidebar), and is named serbrd.hex. After the serial I/O board has been assembled and powered on (supply about 7-8V DC to the board), this firmware must be programmed into the microcontroller. If you have Atmel's STK200 starter kit, you can use the programming software and the programmer that comes with the kit. There is a 10-pin header on the board that accepts the connector on the programmer. Run the software, open a new project, select the chip, click in the program memory window, load the HEX file, erase the chip, and program the device.



Biography

Phil, Ben, and John Bright
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4169 Four Mile Road
Bay City, MI 48706
Phone: **(517) 671-2941**
Email: **serial@winfordeng.com**

We are electrical engineers and programmers who enjoy the hardware and software aspects of interfacing computers to the real world; internet-based automation and network programming are special areas of interest for us. We have worked in the machine tool, Internet, and automobile industries. Winford Engineeringis a small start-up business we are involved in.

Alternatively, the micro can be programmed by connecting your printer port to the DB-25 connector on the board. For this programming method, you will need Johann Aichinger's At-Prog software, which he has made freely available for non-commercial use. It can be downloaded from http://jaichi.virtualave.net/electr-e.htm (click on the AVR link). Run this At-Prog software, make sure the correct port number is selected, open the HEX file, make sure the correct micro is selected (or select the autodetect feature), and click the "Write" button. When finished, click on "Run" to let the micro come out of reset and then disconnect the DB-25 connector.

Incidentally, this second programming method did not work on one of the computers that we used due to some printer port hardware. The printer port, for one reason or another, had some relatively low (about 1k or so) pull-up resistors on its input pins.

Because of the resistance in the analog switch (about 470 ohms), the MISO line was not being pulled down far enough when a logic low was needed. It is believed that there is a problem with this printer port; however, if you experience problems, this would be a good thing to check out. There are some ways around this problem even with this printer port; if any of you have a similar problem, we can probably help you deal with it.

That is all that's necessary to get your new serial I/O board programmed and running with the firmware. In the next issue, we will look at some of the logic behind the firmware, the tasks it performs, and also demonstrate how you can easily use the board from your PC applications.
NV

Part	Component	Qty
Printed Circuit Board		1
C13, C14	27pF Ceramic Capacitor	9
C4 – C12	0.1uF Ceramic Capacitor	9
C1, C3	10uF Electrolytic or Tantalum Cap	2
C2	22uF Electrolytic or Tantalum Cap	1
R1, R8	1k ¼ watt resistor	2
R2 – R7	4.7k ¼ watt resistor	6
U2, U4	74LS245	2
U7	Maxim MAX233 (Digi-Key # MAX233CPP-ND) (Jameco # 106163)	1
U6	Maxim MAX708 (Digi-Key # MAX708CPA-ND)	1
U1	LM7805 Voltage Regulator, TO-220 package	1
Y1	8 MHz Crystal, parallel resonant (Digi-Key # X165-ND)	1
U3	Atmel microcontroller (Digi-Key # AT90S8535-8PC-ND)	1
U5	MC14053 or equivalent (Digi-key # CD4053BCN-ND) (Jameco # 13127)	1
J4	1x3 Header	1
J6 – J9	1x9 Header	3
JP1	2x3 Header	1
JP2	2x5 Header (Jameco # 67811)	1
J10	25-pin D-Sub, male (Jameco #15149)	1
J11	9-pin D-sub, female (Jameco # 104951)	1
J1, J3, J5, J8	Terminal Block: 3 pos, 3.5mm spacing, Weidmuller # 169968 (Digi-Key # 281-1401-ND)	11
D1, D2	LED	2
TO-220	Heatsink	1
	Jumper/Shorting Block (Jameco # 22023)	3
	8-pin Socket	3
	16-pin Socket	1
	20-pin Socket	3
	40-pin Socket	1

NOTE: Etched and drilled PCB boards are available for $20.00 each. You may reserve yours until the end of the month in which this issue came out, at which time we will have the boards made. Please include $3.50 for shipping and handling. To reserve your board, please send your check to:

Winford Engineering, 4169 Four Mile Road, Bay City, MI 48706

Jameco tends to be less expensive than Digi-Key, but not all of the parts are available through Jameco. Some of the Digi-Key and Jameco part numbers have been provided where it was deemed to be helpful.

Resources

Firmware, Software Library, Examples, Documentation
The files are available from two sites:
-The *Nuts & Volts* web site: **www.nutsvolts.com**
-Winford Engineering: **www.winfordeng.com/serial/**

Terminal Program
Teraterm is a freeware terminal program for Windows. Search for 'teraterm' on: **www.tucows.com**

JOHANN AICHINGER'S AVR PROGRAMMER INFORMATION AND SOFTWARE:
http://jaichi.virtualave.net/avr-prog-e.htm

Atmel AVR Microcontroller
AVR assembler/development software:
www.atmel.com/atmel/products/prod203.htm

AVR links for assemblers, compilers, programmers, etc.
www.omegav.ntnu.no/avr/resources.php3

Parts Sources
Jameco Electronics is an excellent source for thousands of electronic parts
www.jameco.com

Digi-Key Corporation: www.digikey.com

Open Channel

by Joseph J. Carr

Fiber Optic Technology — Part 2

Last month, we introduced you to fiber optic technology, and progressed through the dispersion problem. A solution to the dispersion problem is to build an optical fiber with a continuously varying index of refraction that decreases with increasing distance from the optical axis.

While such smoothly varying fibers are not easy to build, it is possible to produce an optical fiber with layers of differing indices of refraction (Figure 1). Such a fiber is known as a graded index fiber.

The overall index of refraction determines the numerical aperture, and is taken as the average of the different layers.

With graded index fibers, the velocity of propagation of the light ray in the material is faster in the layers away from the optical axis than in the lower layers. As a result, a higher-order mode wave will travel faster than a wave in a lower order.

The number of modes available in the graded index fiber is:

$$N = \frac{1}{4}\left(\frac{\pi D [NA]^2}{\lambda}\right)$$

Some cables operate in a critical mode, designated HE_{11} (to mimic microwave terminology), in which the cable is very thin compared with multimodal cables. As the diameter of the core decreases, so does the number of available modes, and eventually the cable becomes single-mode (sometimes, especially in the United Kingdom, called monomodal). If the core is as small as three to five mm, then only the HE11 mode becomes available. The critical diameter required for single-mode operation is:

$$D_{crit} = \frac{2.4\,\lambda}{\pi\,[NA]}$$

Because a single-mode cable reduces the number of available modes, it also reduces intermodal dispersion. Thus, the monomode fiber is capable of extremely high data rates or analog bandwidths.

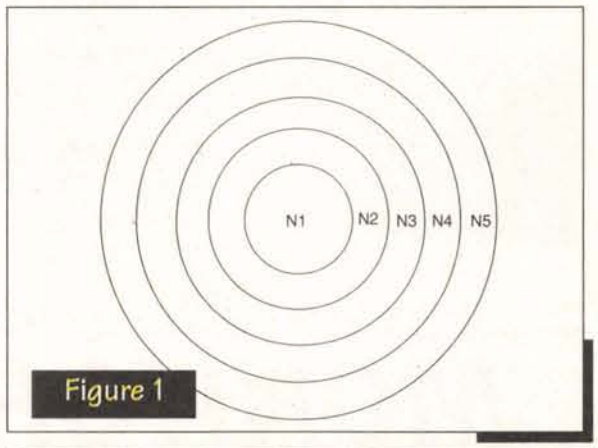


Figure 1

While such smoothly varying fibers are not easy to build, it is possible to produce an optical fiber with layers of differing indices of refraction

LOSSES IN FIBER OPTIC SYSTEMS

Understanding and controlling losses in fiber optic systems is integral to making the system work properly. Before examining the sources of such losses, we will briefly examine the vocabulary used to describe losses in the system, as well as the gains of the electronics systems used to process the signals applied to, or derived from, the fiber optic system. This vocabulary uses the decibel (introduced earlier) in the system of measurement.

In order to analyze systems using simple addition and subtraction — rather than multiplication and division — a little math trick is used on the ratio. We take the base-10 logarithm of the ratio, and then multiply it by a scaling factor (either 10 or 20). For voltage systems, such as our voltage amplifier, the expression becomes:

$$dB = 20 \log\left(\frac{V_o}{V_{in}}\right)$$

The fact that the quantity represented is a gain is indicated by the plus sign. If the quantity represented a loss ($V_o < V_{in}$), then the sign of the result would be negative. Working the problem above for the ratio 0.5/6 results in a loss of -21.6 dB. The numerical result for a loss using the same voltages is the same as for a gain, but the sign is reversed.

Despite the fact that the ratio has been converted to a logarithm, the decibel is nonetheless nothing more than a means for expressing a ratio. Thus, a voltage gain of 12 can also be expressed as a gain of 21.6 dB. A similar expression can be used for current amplifiers, where the gain ratio is I_o/I_{in}:

$$dB = 20 \log\left(\frac{I_o}{I_{in}}\right)$$

For power measurements — which are what is important in light and fiber optic systems — a modified expression is needed in order to account for the fact that power is proportional to the square of the voltage or current:

$$dB = 10 \log\left(\frac{P_o}{P_{in}}\right)$$

We now have three basic equations for calculating decibels: one each for current ratios, voltage ratios, and power ratios. The usefulness of decibel notation is that it can make nonlinear power and gain equations into linear additions and subtractions. Figure 2A shows the losses in fiber optics for the normalized case in terms of output power, and Figure 2B shows the loss in decibels.

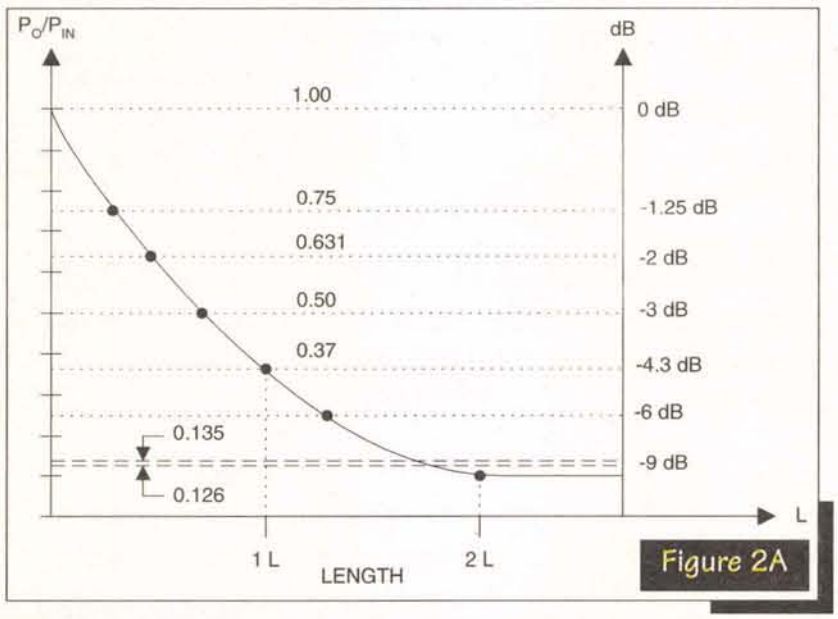


Figure 2A

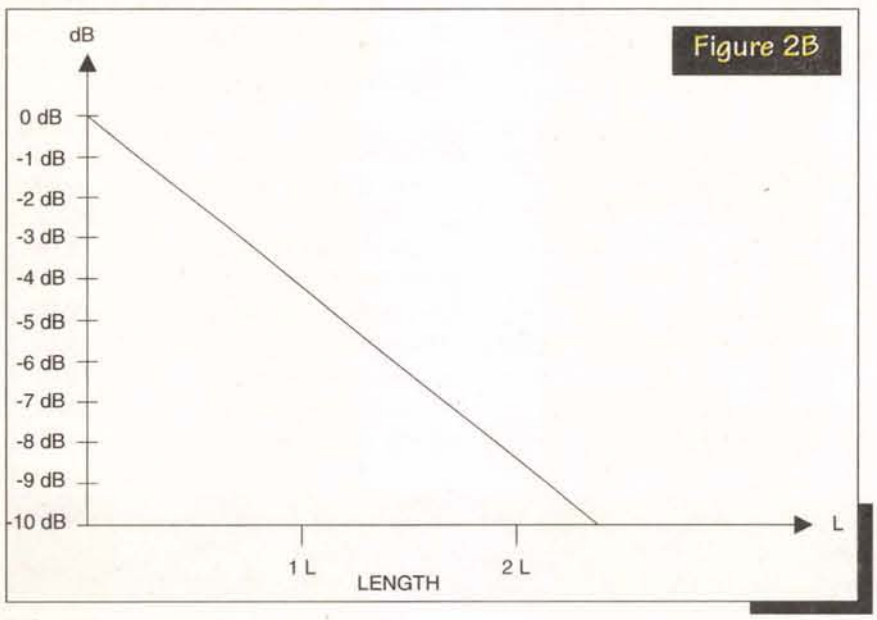


Figure 2B

Figure 2A shows the losses in fiber optics for the normalized case in terms of output power, and Figure 2B shows the loss in decibels.

Mechanisms for Loss

There are several mechanisms for loss in fiber optic systems. Some of these are inherent in any optical system, while others are a function of the design of the specific system being considered.

Defect Losses. Figure 3 shows several possible sources of loss due to defects in the fiber

Fiber Optic Technology — Part 2

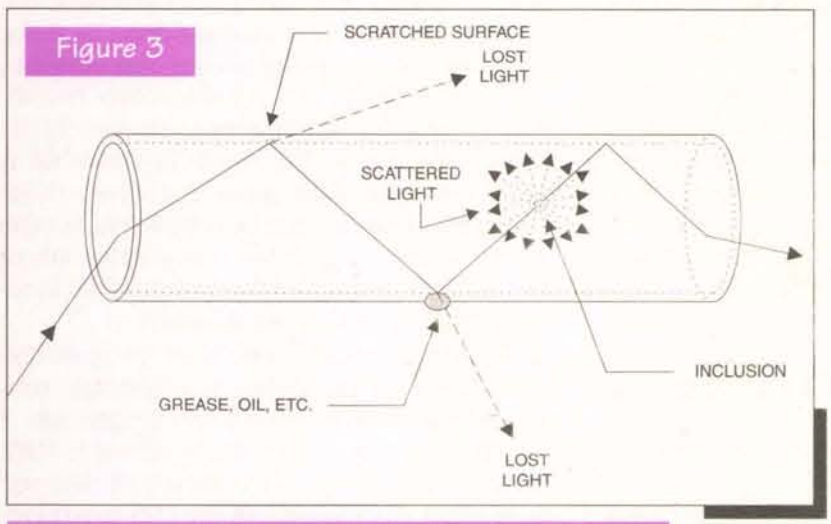


Figure 3

Nicks or scratches that breach the integrity of the surface will allow light to escape.

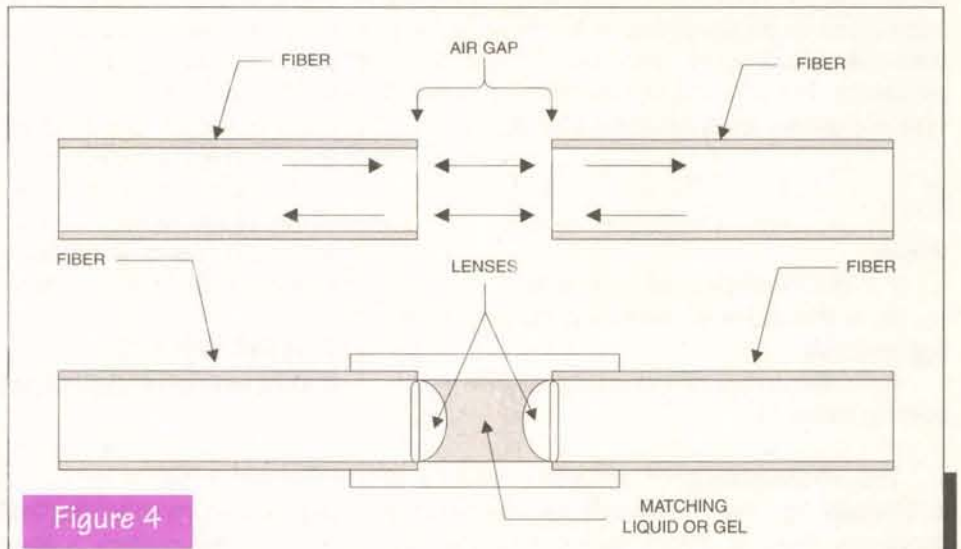


Figure 4

Fresnel Reflection Losses. occur at the interface of an optical fiber with air

itself. In unclad fibers, surface defects (nicks or scratches) that breach the integrity of the surface will allow light to escape. Also in unclad fibers, grease, oil, or other contaminants on the surface of the fiber may form an area with an index of refraction different from what is expected, causing the light direction to change. If the contaminant has an index of refraction similar to that of glass, then it may act as if it were glass and cause loss of light to the outside world.

Finally, there is always the possibility of inclusions: objects, specks, or voids in the material making up the optical fiber. Inclusions can affect both clad and unclad fibers. When light hits an inclusion, it tends to scatter in all directions, causing a loss. Some of the light rays scattered from the inclusion may recombine either destructively or constructively with the main ray, but most do not.

Inverse Square Law Losses. In all optical systems, there is the possibility of losses due to spreading of the beam. Light power per unit area is inversely proportional to the square of the distance ($1/D_2$) from the source. If you shine a flashlight at a wall from a distance of one meter, and measure the power per unit area at the wall, and then move the light back to twice the distance and measure again, you will find that the power has dropped to one-fourth of its original level.

Transmission Losses. These losses are due to light that is caught in the cladding material of clad optical fibers. This light is either lost to the outside, or is trapped in the cladding layer and is thus not available to be propagated in the core.

Absorption Losses. This form of loss is due to the nature of the core material, and is inversely proportional to the transparency of the material. In some materials, absorption losses may not be uniform across the entire light spectrum, but may instead be wavelength sensitive.

Coupling Losses. Another form of loss is due to coupling systems. All couplings have an associated loss. Several different losses of this sort are identified.

Mismatched Fiber Diameters. This form of loss is due to coupling a large-diameter fiber (D_L) to a small-diameter fiber (D_S) so that the larger fiber transmits to the smaller one. In decibel form, this loss is expressed by:

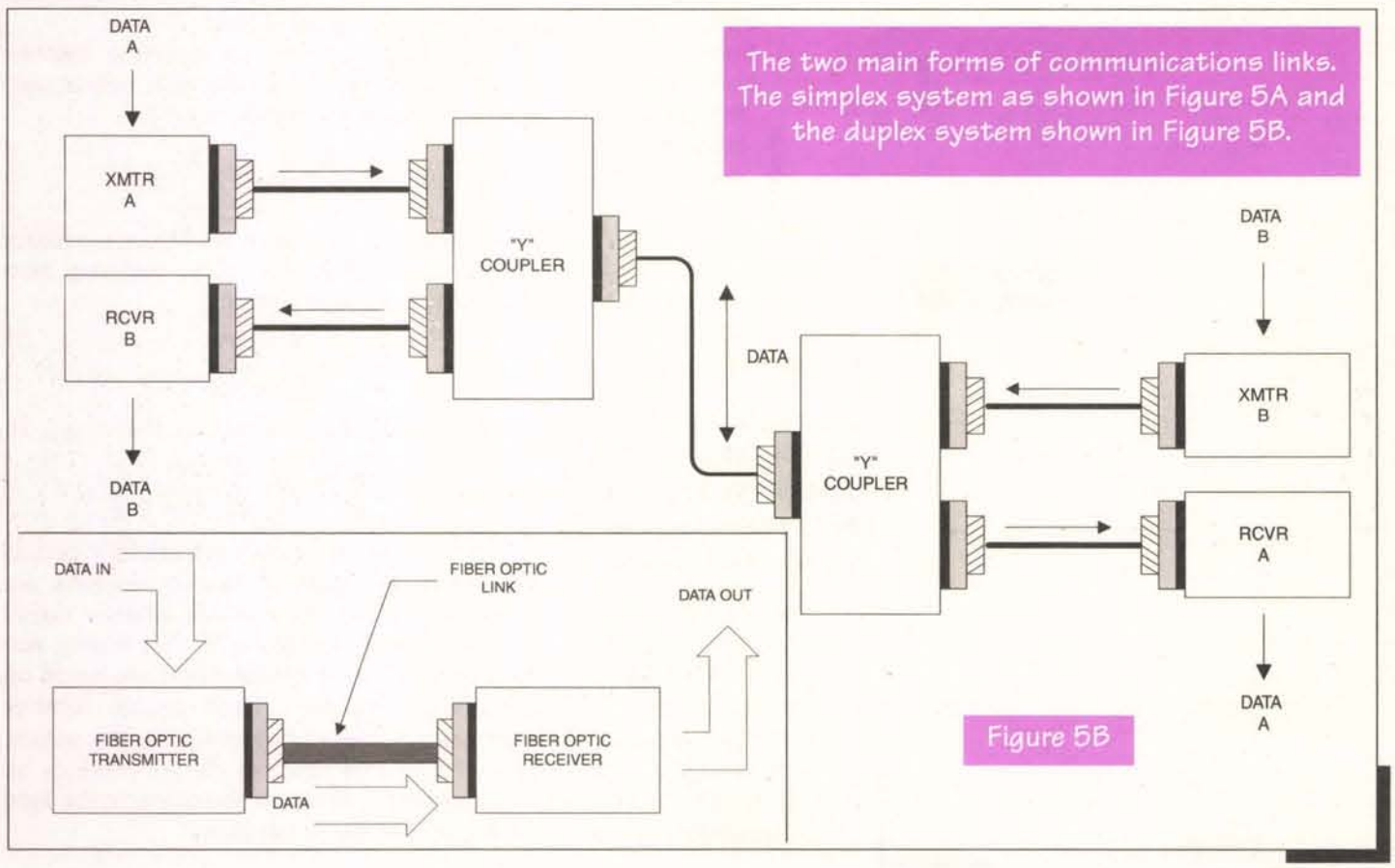
$$dB = -10 \log \left(\frac{D_S}{D_L} \right)$$

Numerical Aperture Coupling Losses. Another form of coupling loss occurs when the numerical apertures of the two fibers are mismatched. If NA_r is the numerical aperture of the receiving fiber, and NA_t is the numerical aperture of the transmitting fiber, then the loss is expressed as:

$$dB = -10 \log \left(\frac{NA_r}{NA_t} \right)$$

Fresnel Reflection Losses. These losses occur at the interface of an optical fiber with air (Figure 4A), and are due to the large change in index of refraction between glass and air. There are actually two losses to consider: the loss caused by internal reflection from the inner surface of the interface, and that caused by reflection from the opposite surface across the air gap in the coupling. Typically, the internal reflection loss is on the order of four percent, while the external reflection loss is about eight percent.

Any form of reflection in a transmission system may be modeled similarly to the modeling of reflections in a



The two main forms of communications links. The simplex system as shown in Figure 5A and the duplex system shown in Figure 5B.

Figure 5B

Fiber Optic Technology — Part 2

radio transmission line. Studying standing waves and related subjects in books on RF systems can yield some understanding of these problems. The amount of reflection in coupled optical systems uses similar arithmetic:

$$\Gamma = \left(\frac{n_1 - n_2}{n_1 + n_2} \right)^2$$

where,

Γ is the coefficient of reflection,

n_1 is the index of refraction for the receiving material,

n_2 is the index of refraction for the transmitting material.

The mismatching of refractive indices is analogous to the mismatch of impedance problems seen in transmission line systems, and the cure is also analogous. Where a transmission line uses an impedance matching coupling device, an optical fiber will use a coupler that matches the "optical impedances," the indices of refraction. Figure 4B shows a coupling between the ends of two fibers (lenses may or may not be used, depending on the system) made with a liquid or gel having an index of refraction similar to that of the fibers. The reflection losses are thereby reduced or even eliminated.

FIBER OPTIC COMMUNICATIONS SYSTEMS

A communications system requires an information signal source (such as voice, music, digital data, or an analog voltage representing a physical parameter), a transmitter, a propagation medium (in this case, optical fibers), a receiver, and an output. In addition, the transmitter may include any of several different forms of encoder or modulator, and the receiver may contain a decoder or demodulator.

Figure 5 shows two main forms of communications link. The simplex system is shown in Figure 5A. In this system, a single transmitter sends information over the path in only one direction to a receiver set at the other end. The receiver cannot reply or otherwise send data back the other way. The simplex system requires only a single transmitter and a single receiver per channel.

A duplex system (Figure 5B) is able to simultaneously send data in both directions, allowing both send and receive capability at each end. The duplex system requires a receiver, a transmitter, and a two-way beam splitting Y-coupler at each end.

Figure 6A

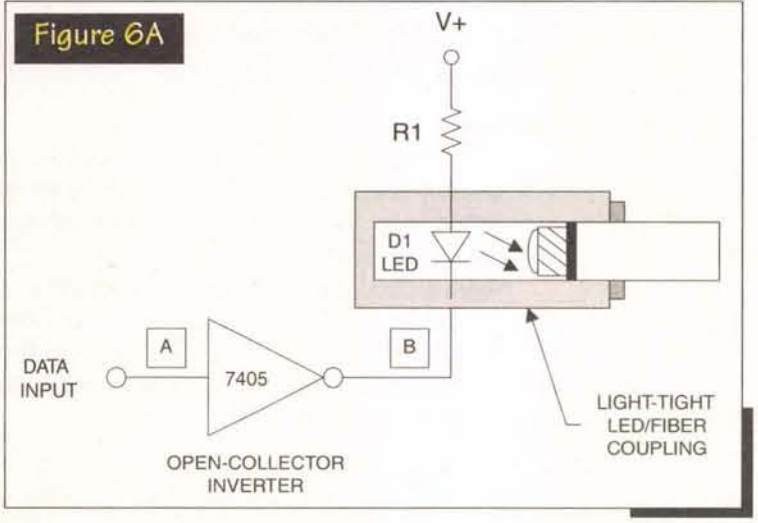


Figure 6B

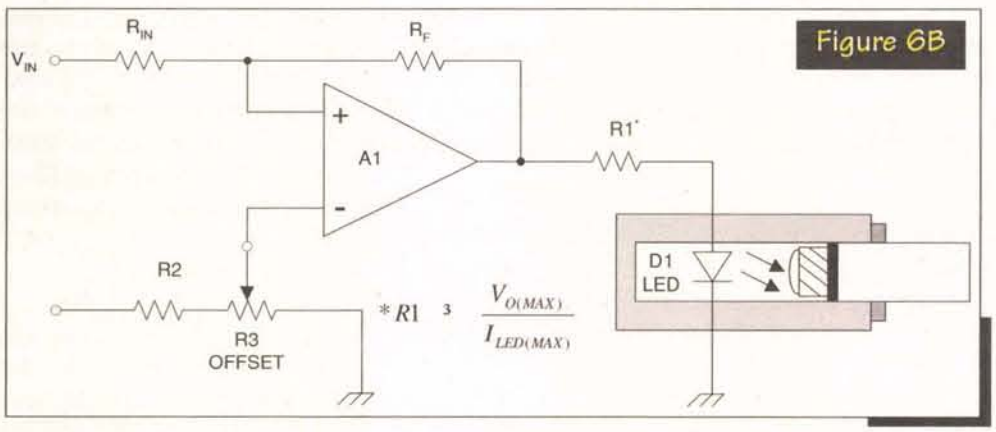
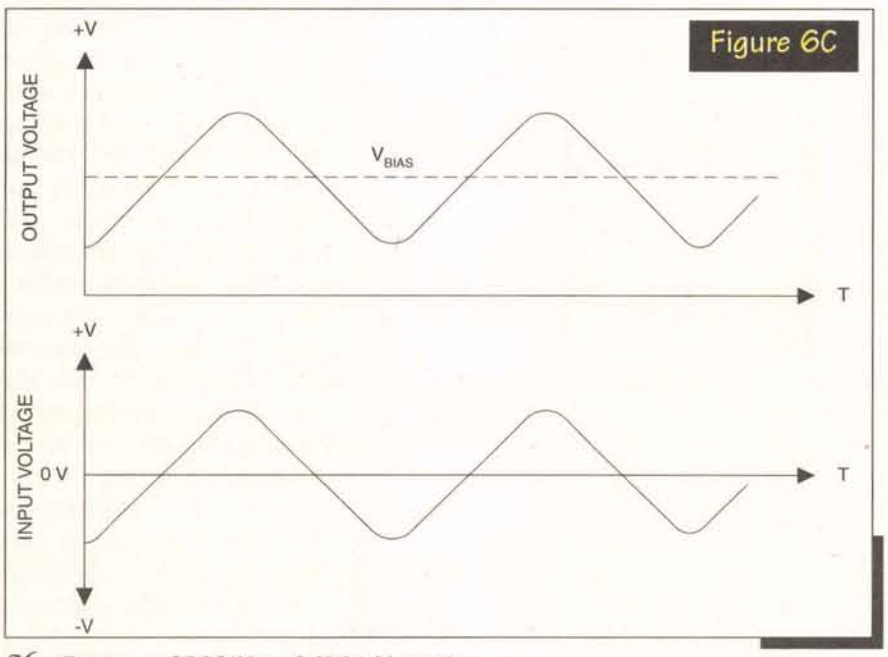


Figure 6C



RECEIVER AMPLIFIER AND TRANSMITTER DRIVER CIRCUITS

Before an optical fiber system is useful for communications, a means must be provided to convert electrical (analog or digital) signals into light beams. Also necessary is a means for converting the light beams back into electrical signals. These jobs are done by driver and receiver preamplifier circuits, respectively.

Figure 6 shows two possible driver circuits. Both circuits use light-emitting diodes (LEDs) as the light source. The circuit in Figure 6A is useful for digital data communications. These signals are characterized by on/off (HIGH/LOW or 1/0) states in which the LED is either ON or OFF, indicating which of the two possible binary digits is required at the moment.

The driver circuit consists of an open-collector digital inverter device in a light-tight container. These devices obey a very simple rule: If the input A is HIGH, then the output B is LOW, and vice versa. Thus, when the input data signal is HIGH, the cathode of the LED is grounded, and the LED turns on and sends a light beam along the optical fiber. When the input data line is LOW, the LED is ungrounded (and therefore turned off), so no light enters the fiber. The resistor R1 is used to limit the current flowing in the LED to a safe value. Its resistance is found from Ohm's law and the maximum allowable LED current:

$$R1 = \frac{(V+) - 0.7}{I_{max}}$$

An analog driver circuit suitable for voice and instrumentation signals is shown in Figure 6B. This circuit is based on the operational amplifier. There are two aspects to this circuit: the signal path and the DC offset bias. The offset bias is needed to place the output voltage at a point where the LED is lighted at about one-half of its maximum brilliance when the input voltage V_{in} is zero. That way, negative polarity signals will reduce the LED brightness, but won't turn it off (see Figure 6C). In other words, biasing avoids clipping off the negative peaks. If the expected signals are monopolar, then V1 should be set to barely turn on the LED when the input signal is zero.

The signal V_{in} sees an inverting follower with a gain of $-R_{if}/R_{in}$, so the total output voltage (accounting for the DC bias) is:

$$V_o = \left(\frac{-V_{in} R_f}{R_{in}} \right) + V1 \left(\frac{R_f}{R_{in}} + 1 \right)$$

Because the network R2/R3 is a resistor voltage divider, the value of V1 will vary from zero volts to a maximum of:

$$V1 = \frac{(V+) R3}{R2 + R3}$$

Therefore, we may conclude that $V_{o(max)}$ is:

$$V_{o(\max)} = \left(\frac{-V_{in} R_f}{R_{in}} \right) + \left(\frac{(V+) R3}{R2 + R3} \right) \left(\frac{R_f}{R_{in}} + 1 \right)$$

Three different receiver preamplifier circuits are shown in Figure 7: analog versions are shown in Figures. 7A and 7B, while a digital version is shown in Figure 7C. The analog versions of the receiver preamplifiers are based on operational amplifiers. Both analog receiver preamplifiers use a photodiode as the sensor. These PN or PIN junction diodes produce an output current I_o that is proportional to the light shining on the diode junction.

Fiber Optic Technology — Part 2

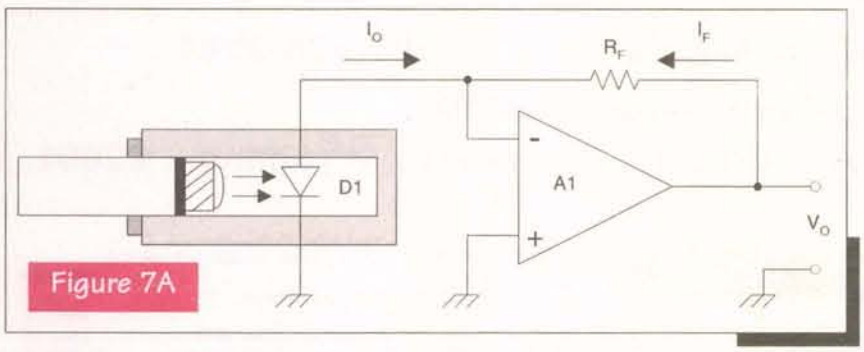


Figure 7A

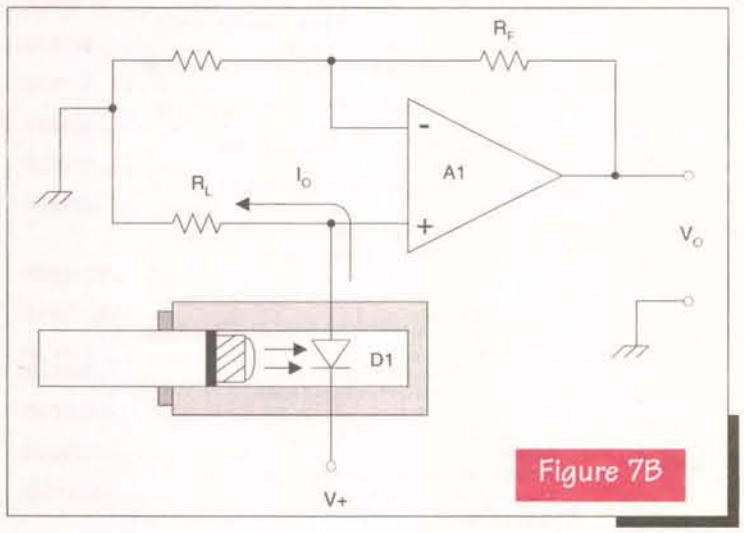


Figure 7B

The version shown in Figure 7A is based on the inverting follower circuit. The diode is connected with its noninverting input grounded, thereby set to zero volts potential, and the diode current is applied to the inverting input. The feedback current I_f exactly balances the diode current, so the output voltage will be:

$$V_o = -I_o R_f$$

The noninverting follower version shown in Figure 7B uses the diode current to produce a proportional voltage drop (V1) across a load resistance R_L. The output voltage for this circuit is:

$$V_o = I_o R_L \left(\frac{R_f}{R_{in}} + 1 \right)$$

Both analog circuits will respond to digital signals, but they are not optimum for that type of signal. Digital signals will have to be reconstructed because of uncertainties caused by dispersion. A better circuit is that of Figure 7C, in which the sensor is a phototransistor connected in the common emitter configuration. When light shines on the base region, the transistor conducts, causing its collector to be at a potential only a few tenths of a volt above ground. Conversely, when there is no light shining on the base, the collector of the transistor is at a potential close to V+, the power supply potential.

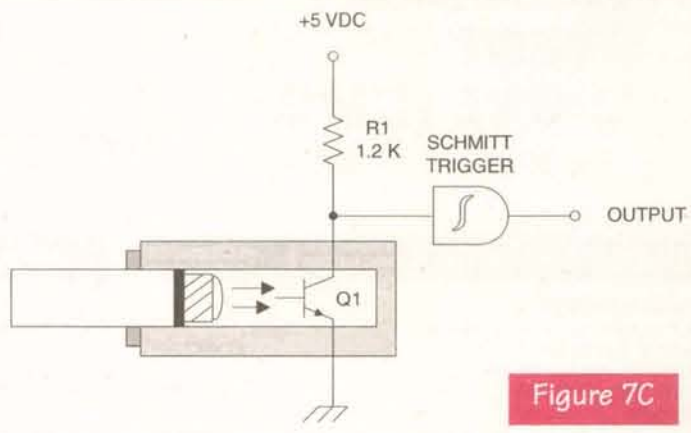


Figure 7C

Clean-up action occurs in the following stage, a digital Schmitt trigger. The output of such a device will snap HIGH when the input voltage exceeds a certain minimum threshold, and remain HIGH until the input voltage drops below another threshold (snap-HIGH and snap-LOW thresholds are not equal). Thus, the output of the Schmitt trigger is a clean digital signal, even though the sensed signal may be blurred. **NV**

HP 85054A Type N Calibration Kit, for HP 8510 series $1,800.00
HP 8511A Frequency Converter, 45 MHz-26.5 GHz, for HP 8510 ..... $6,500.00
HP 8717A Transistor Bias Supply $500.00
HP 8756A Scalar Network Analyzer, HPIB $1,375.00
HP R85026A WR28 Detector, 26.5-40 GHz, for HP 8757 series $1,200.00

SIGNAL GENERATORS

FLUKE 6060A Synthesized Signal Gen., 0.1-1050 MHz, 10 Hz res. $1,500.00
FLUKE 6060B/AK Synthesized Signal Gen., 0.1-1050 MHz, 10 Hz res. $1,900.00
GIGATRONICS 600/6-12 Synthesized Source, 6-12 GHz, 1 MHz res., GPIB $1,800.00
GIGATRONICS 6000/8-16 Synthesized CW Gen., 8-16 GHz, 1 MHz res., +10 dBm $2,250.00
GIGATRONICS 875/50 Levelled Multiplier, x4, 50.0-75.0 GHz output, -3 dBm $2,500.00
GIGATRONICS 900/2-8 Synthesized Signal/Sweep Gen., 2-8 GHz, 1 MHz res.,GPIB $2,000.00
HP 11707A Test Plug-in for HP 8660 series $500.00
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio $450.00
HP 3335A-001 Synthesizer/ Level Gen., 200 Hz-81 MHz, -87 to +13 dBm $3,500.00
HP 8656A-001 Signal Generator, 0.1-990 MHz, 100 Hz res., HPIB, OCXO $1,600.00
HP 8657A-002 Signal Generator, 0.1-1040 MHz, 10 Hz res., HPIB $2,750.00
HP 8660C/86603A/86633B Synthesized Signal Generator, 1-2600 MHz, AM, FM $3,250.00
HP 8671A Synthesized CW Gen., 2-6 GHz, 1 kHz res., +8 dBm $2,750.00
HP 8672A Synthesized Signal Generator, 2-18 GHz, +3 dBm output $4,500.00
HP 8673H-212 Synthesized Signal Generator, 2.0-12.4 GHz, 1 kHz res. $8,750.00
HP 8684B Signal Generator, 5.4-12.5 GHz, AM/ WBFM/ Pulse $3,000.00
WAVETEK 952 Signal Generator, 1-4 GHz, +10 dBm, AM, FM $750.00
WAVETEK 954 Signal Generator, 3.7-7.6 GHz, +7 dBm, AM, FM $750.00
WAVETEK 957 Signal Generator, 12-18 GHz, +7 dBm, AM, FM $750.00

SWEEP GENERATORS

HP 8350B/83522A Sweep Oscillator, 10-2400 MHz, +13 dBm levelled $3,900.00
HP 8350B/83540A-002,004 Sweep Oscillator, 2.0-8.4 GHz, 70 dB step attenuator $3,900.00
HP 8350B/83545A-002 Sweep Oscillator, 5.9-12.4 GHz, 70 dB step attenuator $3,900.00
HP 8350B/83590A Sweep Generator, 2-20 GHz, +10 dBm levelled $6,500.00
HP 83570A RF Plug-in, 18.0-26.5 GHz, +10 dBm levelled $6,000.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled $400.00
HP 8620C Sweep Oscillator Frame $550.00
HP 86222B-002 RF Plug-in, 10-2400 MHz, +13 dBm lvld., 70 dB step att. $1,250.00
HP 86222B-E69/8620C Sweep Oscillator, 0.01-2 GHz & 2-4 GHz, +10 dBm, w/frame $1,500.00
HP 86235A-001 RF Plug-in, 1.7-4.3 GHz, +16 dBm levelled $400.00
HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled $300.00
HP 86260A-H04 RF Plug-in, 10.0-15.0 GHz, +10 dBm unlevelled .. $400.00
HP 86290A RF Plug-in, 2.0-18.0 GHz, +7 dBm levelled $1,200.00
HP 86290B RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled $1,650.00
HP 86290C RF Plug-in, 2.0-18.6 GHz, +13 dBm levelled $1,850.00
WAVETEK 2001 Sweep Generator, 1-1400 MHz, +10 dBm, 70 dB step atten. $900.00
WAVETEK 2002A Sweep Generator, 1-2500 MHz, +10 dBm, 70 dB step atten. $1,200.00
WAVETEK 962 Sweep Generator, 1.0-4.0 GHz, markers, +12 dBm unlvld. $950.00
WILTRON 6717B-20 Freq. Synth./ Sweeper, 10 MHz-8.4 GHz, +13 dBm, AM, FM $6,500.00

POWER METERS

BOONTON 42B/41-4E Analog Power Meter, with 1 MHz-18 GHz sensor $450.00
HP 432A/478A Power Meter, -30 to +10 dBm, 10 MHz-10 GHz $300.00
HP 435B/8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz $900.00
HP 435B/8482B Power Meter, 0 to +43 dBm, 100 kHz-4.2 GHz $1,500.00
HP 436A-022/8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz, HPIB $1,200.00
HP 436A-022/8484A Power Meter, -70 to -20 dBm, 10 MHz-18 GHz, HPIB $1,200.00
HP Q8486A Power Sensor, 33.0-50.0 GHz, WR22, for 435/6/7/8 ..... $1,500.00
HP R8486A WR28 Power Sensor, 26.5-40 GHz, for HP 435/6/7/8 ..... $1,500.00

RF MILLIVOLTMETERS

BOONTON 92C RF Millivoltmeter, 3 mV-3 V f.s., 10 kHz-1.2 GHz $500.00
RACAL-DANA 9303 RF Millivoltmeter, 10 kHz-2 GHz, -70 to +20 dBm $750.00

AMPLIFLIERS MISCELLANEOUS

AMPLIFIER RESEARCH 4W1000 Amplifier, 40 dB gain, 4 Watts, 1-1000 MHz $950.00
BOONTON 82AD Modulation Meter, AM / FM, 10-1200 MHz $650.00
ENI 310L Amplifier, 50 dB gain, 250 kHz-110 MHz, 10 Watts output $1,200.00
HP 11729B-003 Carrier Noise Test Set, 5 MHz-3.2 GHz $2,250.00
HP 415E SWR Meter $200.00
HP 8347A Amplifier, 25 dB gain, 100 kHz-3 GHz, +22 dBm $2,900.00
HP 8406A Comb Generator, 1/ 10/ 100 MHz increments, to 5 GHz $500.00
HP 8447A Amplifier, 20 dB, 0.1-400 MHz, 5 dB NF, +6 dBm output $375.00
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output $750.00
HP 8447F-H64 Dual Amp., 9 kHz-50 MHz 28 dB & 0.1-1300 MHz 25 dB $900.00
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz $1,500.00
HP 8901B-1,2,3 Modulation An., 0.15-1300 MHz, rear input, OCXO, ext.LO $2,000.00
HUGHES 1177H01F000 TWT Amplifier, >30 dB gain, 2-4 GHz, 10 Watts output $1,750.00
HUGHES 1177H10F000 TWT Amplifier, >30 dB gain, 1.4-2.4 GHz, 20 Watts $2,500.00
HUGHES 8010H13F000 TWT Amplifier, >30 dB gain, 3-8 GHz, 10 Watts $2,500.00
RF POWER LABS ML50 Amplifier, 2-30 MHz, 47 dB gain, 50 Watts, metered, 28V $275.00
ROHDE & SCHWARTZ ESH2 Test Receiver, 9 kHz-30 MHz $3,750.00

COAXIAL & WAVEGUIDE

AEROWAVE 28-3000/10 WR28 Directional Coupler, 10 dB, 26.5-40 GHz $300.00
AMERICAN NUCLEONICS AM-432 Cavity Backed Spiral Antenna, LHC, 2-18 GHz,TNC(f) *NEW* $95.00
AVANTEK AMT-400X2 WR28 Active Doubler, +10 dBm in/ +10 dBm out 26-40 GHz $450.00
BIRD 6735-300 1 kW Load, 25-1000 MHz, LC(f), with wattmeter $650.00
BIRD 8201 500 Watt Oil Dielectric Load, DC-2.5 GHz, N(f) $350.00
FXR/MICROLAB SL-03N Stub Stretcher, 0.3-6.0 GHz, 100 Watts max., N(m/f) $75.00
GR 874-LTL Constant Impedance Trombone Line, 0-44 cm, DC-2 GHz $400.00
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7 ..... $450.00
HP 11636A 2-Way Power Divider, DC-18 GHz, N(m/f/f) $300.00
HP 11691D-001 Directional Coupler, 22 dB, 2-18 GHz, N(f)-all ports $450.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz $800.00
HP 33321K Programmable Step Atten., 0-70 dB, DC-26.5 GHz, 3.5mm $475.00
HP 33327L-006 Programmable Step Attenuator, 0-70 dB, DC-40 GHz, 2.9mm $1,000.00
HP 774D Dual Directional Coupler, 20 dB, 215-450 MHz $275.00
HP 776D Dual Directional Coupler, 20 dB, 940-1900 MHz $275.00
HP 777D Dual Directional Coupler, 20 dB, 1.9-4.1 GHz $275.00
HP 778D-011 Dual Dir. Coupler, 20 dB, 100-2000 MHz, APC7 test port $450.00
HP 779D Directional Coupler, 20 dB, 1.7-12.4 GHz $400.00
HP 8431A 2-4 GHz Band Pass Filter, N(m/f) $150.00
HP 8494G-002 Programmable Step Attenuator, 0-11 dB, DC-4 GHz, SMA $350.00
HP 8496A-002 Step Attenuator, 0-110 dB, DC-4 GHz, SMA *UNUSED* $400.00
HP 87300C-020 Directional Coupler, 20 dB, 1.0-26.5 GHz, 3.5mm $475.00
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz $350.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz $450.00
HP K752A WR42 Directional Coupler, 3 dB, 18.0-26.5 GHz $450.00
HP K752C WR42 Directional Coupler, 10 dB, 18.0-26.5 GHz $450.00
HP K752D WR42 Directional Coupler, 20 dB, 18.0-26.5 GHz $450.00
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz $275.00
HP K914B WR42 Moving Load, 18.0-26.5 GHz $300.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz $650.00
HP R422A WR28 Crystal Detector, 26.5-40 GHz $400.00
HP R752D WR28 Directional Coupler, 20 dB, 26.5-40 GHz $450.00
HP R914B WR28 Moving Load, 26.5-40 GHz $250.00
HP V365A WR15 Isolator, 25 dB, 50-75 GHz $750.00
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz $650.00
HP X870A WR90 Slide Screw Tuner $150.00
HUGHES 45322H-1110/1120 WR22 Directional Couplers, 10 or 20 dB, 33-50 GHz $350.00
HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz $750.00
HUGHES 45714H-1000 WR15 Frequency Meter, 50-75 GHz $900.00
HUGHES 45721H-2000 WR28 Direct Reading Attenuator, 0-50 dB, 26.5-40 GHz $1,000.00
HUGHES 45722H-1000 WR22 Direct Reading Attenuator, 0-50 dB, 33-50 GHz $1,000.00
HUGHES 45724H-1000 WR15 Direct Reading Attenuator, 0-50 dB, 50-75 GHz $1,000.00
HUGHES 45732H-1200 WR22 Level Set Attenuator, 0-25 dB, 33-50 GHz $250.00
HUGHES 45752H-1000 WR22 Direct Reading Phase Shifter, 0-360 deg.,33-50 GHz $1,400.00
HUGHES 45772H-1100 WR22 Thermistor Mount, -20 to +10 dBm, 33-50 GHz $400.00
HUGHES 45773H-1100 WR19 Thermistor Mount, -20 to +10 dBm, 40-60 GHz $650.00
HUGHES 45774H-1100 WR15 Thermistor Mount, -20 to +10 dBm, 50-75 GHz $750.00
HUGHES 47316H-1111 WR10 Tuneable Detector, 75-110 GHz, positive polarity $600.00
HUGHES 47741H-2310 WR28 Phase Locked Gunn Osc., 32.000 GHz, +18 dBm $2,000.00
HUGHES 47742H-1210 WR22 Phase Locked Gunn Osc., 42.000 GHz, +18 dBm $2,750.00
KRYTAR 201020010 Directional Detector, 1-20 GHz, SMA(f/f)/SMC $200.00
KRYTAR 2616S Directional Detector, 1.7-26.5 GHz, K(f/m)/SMC $200.00
M/A-COM 3-19-300/10 WR19 Directional Coupler, 10 dB, 40-60 GHz $450.00
MICA C-121S06 Circulator, 17.5-24.5 GHz, SMA(f/m/m) $75.00
MINI-CIRCUITS ZFDC-20-4 Directional Coupler, 19.5 dB, 1-1000 MHz, SMA(f) $25.00
NARDA 3000-SERIES Directional Couplers $150.00
NARDA 3020A Bi-Directional Coupler, 50-1000 MHz, N $500.00
NARDA 3022 Bi-Directional Coupler, 20 dB, 1-4 GHz $400.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz $375.00
NARDA 3090-SERIES Precision High Directivity Couplers $225.00
NARDA 368BNM Coaxial High Power Load, 500 Watts, 2.0-18 GHz, N(m) $500.00
NARDA 3752 Coaxial Phase Shifter, 0-180 deg./GHz, 1-5 GHz $1,000.00
NARDA 3753B Coaxial Phase Shifter, 0-55 deg./GHz, 3.5-12.4 GHz $1,000.00
NARDA 4000-SERIES SMA Miniature Directional Couplers $75.00
NARDA 4242-20 Directional Coupler, 20 dB, 0.5-2.0 GHz, SMA(f) $100.00
NARDA 4247-20 Directional Coupler, 20 dB, 6.0-26.5 GHz, 3.5mm(f) $200.00
NARDA 4247B-10 Directional Coupler, 10 dB, 6.0-26.5 GHz, 3.5mm(f) $200.00
NARDA 5070-SERIES Precision Reflectometer Couplers $300.00
NARDA 562 DC Block, 10 MHz-12.4 GHz, 100 V max., N(m/f) $65.00
NARDA 765-10 10 dB Attenuator, 50 Watts, DC-5 GHz, N(m/f) $165.00
NARDA 791FM Variable Attenuator, 0-37 dB, 2.0-12.4 GHz $600.00
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz $375.00
NARDA 793FM Direct Reading Variable Attenuator, 0-20 dB, 4-8 GHz $225.00
NARDA 794FM Direct Reading Variable Attenuator, 0-40 dB, 4-8 GHz $375.00
OMNI-SPECTRA 2085-6010-00 Crystal Detector, 1-18 GHz, negative polarity, SMA(m/f) $50.00
PAMTECH KYG1014 WR42 Junction Circulator, 18.0-26.5 GHz $250.00
SONOMA SCIENTIFIC 21A3 WR42 Circulator, 20 dB, 20.6-24.8 GHz $75.00
TEKTRONIX 2701 Step Attenuator, 0-79 dB, DC-1 GHz, AC or DC coupled $175.00
TRG B510 WR22 Direct Reading Attenuator, 0-50 dB, 33-50 GHz $900.00
TRG V510 WR15 Direct Reading Attenuator, 0-50 dB, 50-75 GHz $900.00
TRG V551 WR15 Frequency Meter, 50-75 GHz $600.00
TRG W510 WR10 Direct Reading Attenuator, 0-50 dB, 75-110 GHz $1,000.00
TRG W551 WR10 Frequency Meter, 75-110 GHz $750.00
WAVELINE 100080 WR28 Terminated Crossguide Coupler, 30 dB $200.00
WEINSCHEL 150-110 Programmable Step Attenuator, 0-110 dB, DC-18 GHz, SMA $450.00
WEINSCHEL DS109 Double Stub Tuner, 1-13 GHz, N(m/f) $150.00
WEINSCHEL DS109LL Double Stub Tuner, 0.2-2.0 GHz, N(m/f) $150.00

COMMUNICATIONS

HP 4935A Transmission Impairment Measuring Set $600.00
HP 59401A HPIB Bus Analyzer $375.00
MICRODYNE 1200MR 215-320 MHz Telemetry Receiver, PSK demodulation $450.00
TEK 1411R PAL Gen.,w/SPG12 sync; TSG11 color bars;TSG13 linearity $750.00
TEK 1411R PAL Test Gen., w/SPG12,TSG11, TSG13,TSG15,TSG16 ..... $1,000.00
TEK 1411R PAL Test Gen., w/SPG12,TSG11, TSG12,TSG13,TSG15,TSG16 ..... $1,100.00
TEK 1411R-opt.04 PAL Test Gen.,w/ SPG12,TSG11,TSP11,TSG13,TSG15,TSG16 ..... $1,400.00
TEK 147A NTSC Test Signal Generator, with noise test signal $800.00
TEK 148 PAL Insertion Test Signal Generator $700.00
TEK 520A NTSC Vectorscope $750.00
TEK 521A PAL Vectorscope $750.00

MISCELLANEOUS

EG&G / P.A.R. 5302 / 5316 Lock-in Amplifier, 100 mHz-1 MHz, GPIB / RS232C $2,250.00
FLUKE 2180A RTD Digital Thermometer $500.00
HP 59307A HPIB VHF Switch $200.00
P.A.R. 5206-95,98 Two-Phase Lock-in Amp., 2 Hz-100 kHz, GPIB $1,500.00
TEK TM5003 5000-series 3-slot Programmable Power Module $450.00
TEK TM5006 5000-series 6-slot Programmable Power Module $500.00
TEK TM504 500-series 4-slot Power Module $175.00
TEK TM506 500-series 6-slot Power Module $250.00
TEK TM515 500-series 5-slot Traveller Power Module $250.00

USING VOLTAGE REFERENCE AND TEMPERATURE SENSOR ICs (Part 2)

by Ray Marston

Ray Marston shows – in this second episode of this three-part series – how to use various popular 'current source' and 'temperature sensor' ICs.

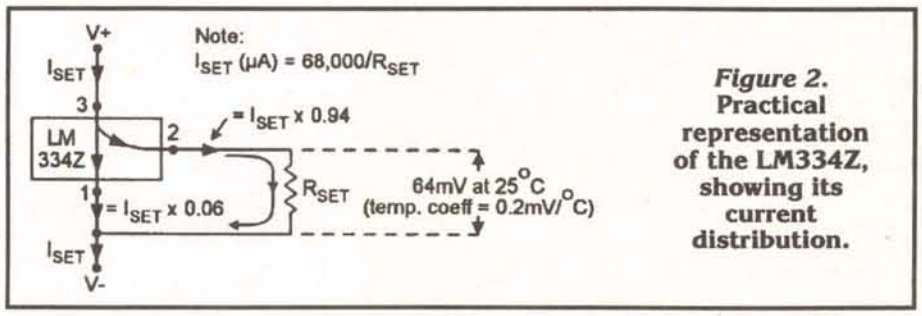
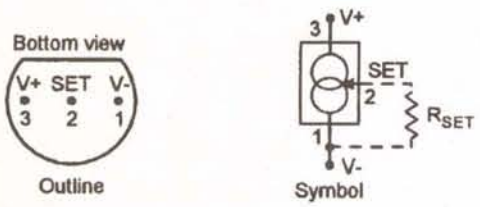


Figure 2. **Practical representation of the LM334Z, showing its current distribution.**



Operating voltage range	= 1V to 30V
Operating current range	= 1µA to 10mA
Current regulation accuracy	= 0.02%/V (typical)
Current sensitivity	= 0.068V/R_{SET}
Temp. coefficient	= 0.33%/°C
R_{SET} value (at 25°C)	= 68,000/I(µA)

Basic specification

Figure 1. **Basic details of the LM334Z adjustable current source IC.**

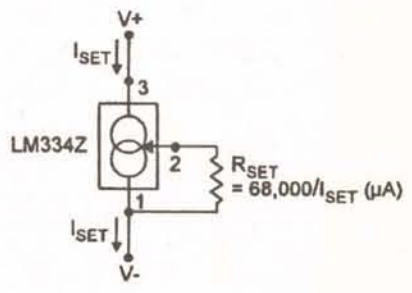


Figure 3. **Basic LM334Z floating or 'two-terminal' current source circuit.**

Last month's opening episode of this three-part series dealt exclusively with popular voltage reference ICs. This month's episode begins by describing practical applications of the popular LM334Z adjustable current source IC, and then goes on to present practical application data on three popular temperature sensor ICs manufactured by National Semiconductor.

'CURRENT SOURCE' ICs

So far, this mini-series has dealt only with 'voltage reference' ICs. The present section moves on from this subject and deals with 'current source' ICs. These devices act as constant-current generators or sinks, and pass a fixed or preset operating current that has a value that is virtually independent of variations in the device's operating voltage. Such devices are widely used in precision bias networks and linear ramp generators, etc.

The best known commercial-grade 'current source' IC is the LM334, which is manufactured by National Semiconductor and is available in a variety of sub-types, in various packaging styles. The best known of these is the LM334Z, which is housed in a three-pin TO-92 plastic package (an almost identical device, the LM 334N, is available from SGS Thomson). The LM334Z can be regarded as a high-performance 'floating' constant-current generator that can be used with supplies in the 1V to 30V range and can have its operating current set to any value between 1µA and 10mA via a single external resistor (R_{SET}). *Figure 1* shows basic details of the LM334Z.

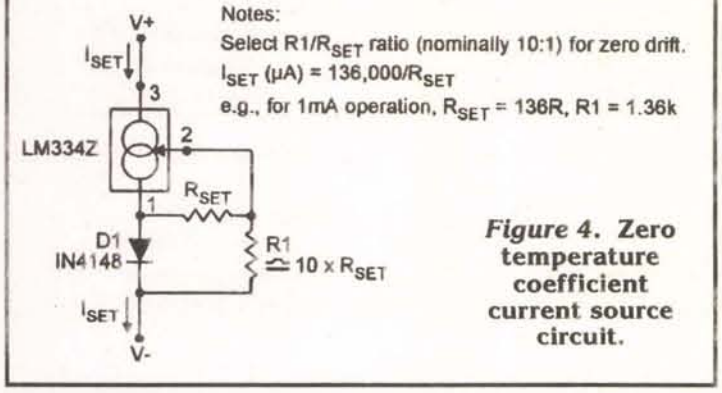


***Figure 4.* Zero temperature coefficient current source circuit.**

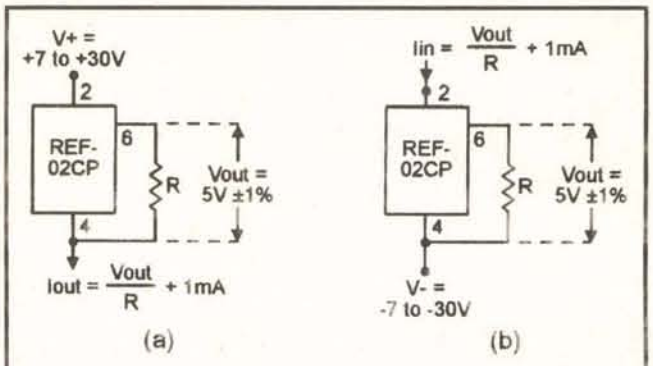


***Figure 6.* Ways of using the REF-02CP IC as (a) a constant current source or (b) a constant current sink.**

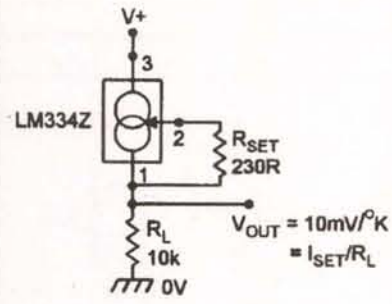


***Figure 5.* Degrees-Kelvin (°K) temperature-to-voltage converter circuit.**

***Figure 7.* Temperature sensor IC selection chart (National Semiconductor 'commercial-grade' devices).**

Parameter	LM34CZ	LM35CZ	LM335Z
Temp. range	-40°F to +230°F	-40°C to +110°C	-40°C to +100°C
Spot accuracy (typ.)	±0.8°F at +77°F	±0.4°C at +25°C	±2°C at +25°C
Range accuracy (typ.)	±1.6°F	±0.8°C	±4°C
Output scale	10mV/°F	10mV/°C	10mV/°K
Supply voltage range	5-30V	4-30V	N.A.
Quiescent current	70µA	60µA	0.4-5mA

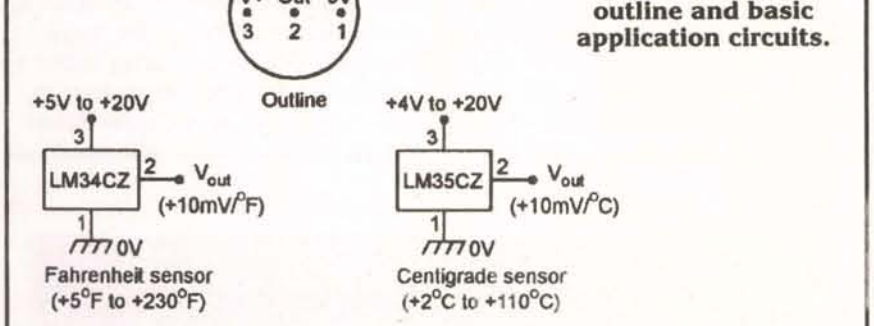


***Figure 8.* LM34CZ/LM35CZ outline and basic application circuits.**

Note that the LM334Z symbol in *Figure 1* perhaps gives a deceptive impression of the device's operation. A more accurate representation of the device action is shown in *Figure 2*, where the following points should be noted. The I_{SET} current flowing into the LM334Z via pin 3 splits within the device, with only six percent of it flowing to the negative rail (as a 'bias' current) via pin 1, and with the other 94 percent flowing to the negative rail via pin 2 and R_{SET}. At 25°C, a voltage of 64mV is developed across R_{SET} (between pins 2 and 1), and this voltage has a temperature coefficient of +0.2mV/°C. Thus, I_{SET} is temperature-sensitive, and at 25°C has a value (in µA) of 68,000/R_{SET}.

Figure 3 shows the basic way of using the LM334Z as a floating 'two-terminal' current source (or current sink).

The R_{SET} value determines the IC's operating (I_{SET}) current, using the formula shown in the diagram. Spot R_{SET} values are 6k8 at 10µA, 680R at 100µA, 68R at 1mA, and 13R6 at 5mA. Note that, since identical currents flow into the circuit from the positive rail (the 'sink' current) and out of it towards the negative rail (the 'source' current), the circuit can be used as either a constant-current sink or a constant-current source.

Figure 4 shows how the above circuit can be modified, with the aid of D1 and R1, to eliminate the temperature sensitivity of the current source (D1 must share the thermal environment of the LM334Z).

Finally, *Figure 5* shows how the LM334Z can be used as a temperature-to-voltage converter that gives an output of +10mV/°K.

Before leaving the subject of 'current source' ICs, note that the REF-02CP voltage reference IC that was described in last month's article (and also the REF-01 and REF-03 types, also described last month) can be used as a precision current source or current sink by using it in the basic ways shown in *Figure 6*.

TEMPERATURE SENSOR IC BASICS

Temperature sensor ICs are simple devices that convert temperature directly into voltage. National Semiconductor is a leading producer of ICs of this type, and *Figure 7* shows basic details of the three most popular low-cost 'commercial-grade' devices in their range. Here, the LM34CZ and LM35CZ are precision 'micropower' devices that give outputs proportional to °F and °C, respectively, and the LM335Z is a simple trimmable device that gives an output proportional to °K. The rest of this month's article gives practical application details of these three ICs.

LM34CZ/LM35CZ circuits

The LM34CZ and LM35CZ are housed in three-pin TO-92 packages, and are designed to consume quiescent currents of only a few dozen microamps, to minimize internal heating effects; both ICs can, however, produce output drive current of up to 10mA. *Figure 8* shows the outline and basic application circuits of these ICs; note that these simple single-supply circuits give minimum temperature

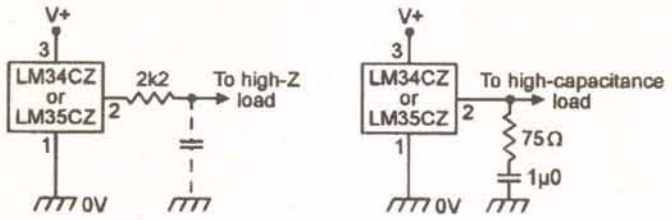


Figure 11. **Methods of driving high-capacitance loads.**

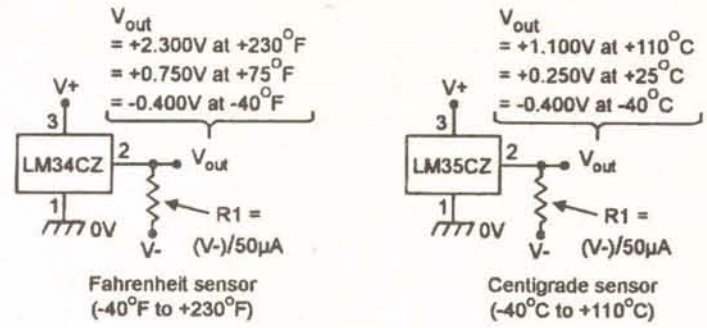


Figure 9. **LM34CZ/LM35CZ full-range temperature sensor circuits.**

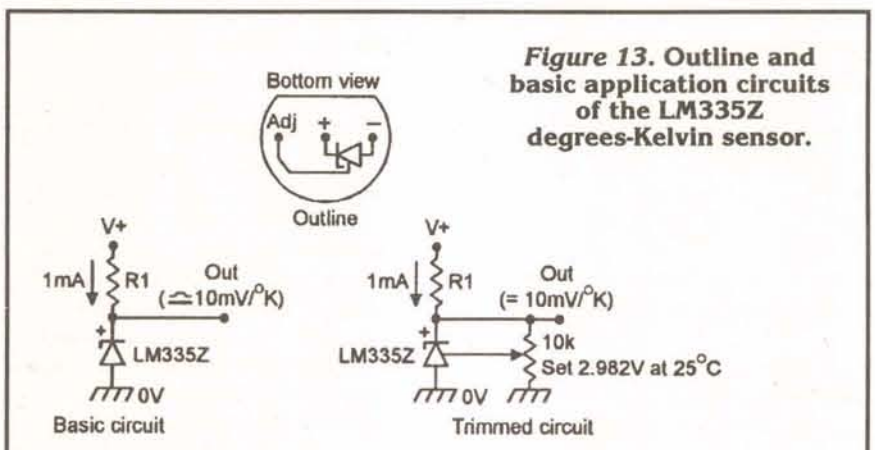


Figure 13. **Outline and basic application circuits of the LM335Z degrees-Kelvin sensor.**

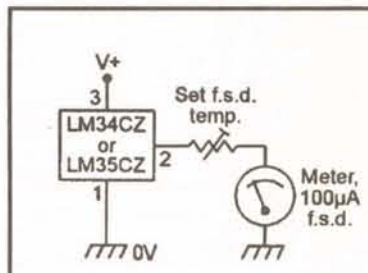


Figure 12. **Analog °F or °C meter.**

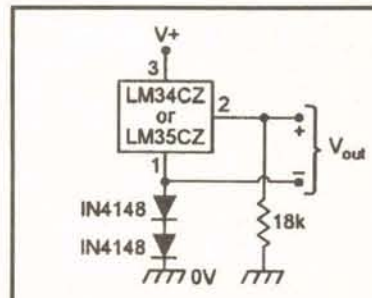


Figure 10. **Single-supply full-range temperature sensor.**

readings of +5°F or +2°C.

The LM34CZ and LM35CZ ICs can be made to give full-range outputs (i.e., to give temperature readings down to -40°F or -40°C) by using the two-supply connection shown in *Figure 9*, or the simulated two-supply connection in *Figure 10* (in which a bias voltage of about 1.2V is generated across the two series-wired IN4148 silicon diodes and is applied to pin 1 of the IC).

Note that (like most micropower ICs) the LM34CZ and LM35CZ tend to become unstable if their outputs are directly loaded by capacitive loads greater than a few picofarads (pFs). This problem can easily be overcome by feeding such loads in either of the ways shown in *Figure 11*, using either a series resistor (2k2 or greater) in the output line, or a simple Zobel-

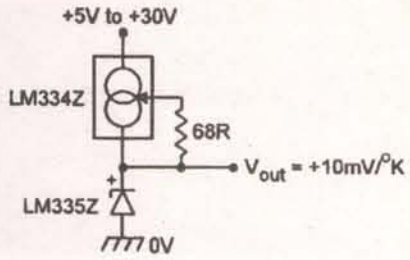


Figure 14. **Operation from a wide-range supply voltage.**

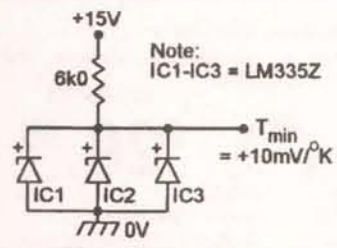


Figure 15. **Multi-input minimum-temperature sensor circuit.**

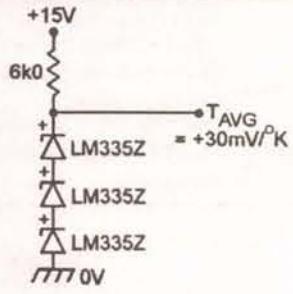


Figure 16. **Multi-input average-temperature sensor circuit.**

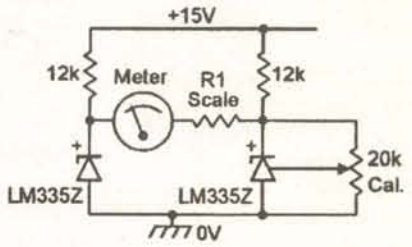


Figure 17. **Differential temperature analog meter circuit.**

type load across the output.

Finally, note that these ICs can be used as an analog thermometer by connecting their outputs to a reasonable sensitive moving-coil meter via a suitable 'ranging' resistor, as shown in the basic circuit in *Figure 12*, in which the IC is shown driving a 100µA moving coil meter.

LM335Z circuits

The LM335Z acts like a temperature-sensitive trimmable zener diode that gives an output of +10mV/°K (e.g., 2.732V at 0°C, or 2.982V at +25°C).

Figure 13 shows the IC's outline and simple ways of using the device in either the basic or the 'trimmable' (precision) mode; note in these circuits that the R1 value is chosen to set the IC's current at about 1mA.

Figure 14 shows how the basic circuit can be modified for 1mA operation (via the LM334Z constant-current generator) when using a wide-range supply.

Figure 15 shows three LM335Zs used in a circuit that gives an output proportional to the lowest of three sensed temperatures, and *Figure 16* shows a circuit that gives an output proportional to the average of three independent readings.

Finally, *Figure 17* shows how two sensor ICs can be used to make a differential temperature analog meter. The meter should be a center-reading (50µA-0-50µA) 100µA type; the CAL control is initially set to give zero reading when both ICs are at the same temperature, and R1 is chosen to set the desired full-scale differential reading. **NV**

Next month, Ray completes the series with a further selection of how to use popular 'temperature sensor' ICs.

Events

CALENDAR

The Events Calendar is a free service for publicizing electronic events such as amateur radio hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days in advance. Include your flyer, estimated attendance, name of the person to contact, and phone number.

Complimentary issues are available upon request for distribution to your attendees. A street address for UPS is required.

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Corona, CA 92879
Phone 909-371-8497
Fax 909-371-3052
E-mail events@nutsvolts.com

FEBRUARY 2001

February 2-3

MS - JACKSON - Convention. Trade Mart Bldg., Fairgrounds. Fri: 5pm-8pm, Sat: 8am-4pm. VE testing. Talk-in: 146.76-. Jackson ARC, Ron Brown AB5WF, 601-956-1448. Email: ab5wf@arrl.net Web: http://www.jxnarc.org

February 3

KS - LA CYGNE - Hamfest. Mine Creek ARC, Ron Cowan KB0DTI, 913-757-4455. Email: kb0dti@arrl.net
MI - NEGAUNEE - Hamfest. Hiawatha ARA, Bill Beitel N8NRG, 906-226-2779. Email: n8nrg@portup.com
Web: http://www.qsl.net/k8lod/
SC - NORTH CHARLESTON - Hamfest. Charleston ARS, Jenny Myers WA4NGV, 843-747-2324. Email: brycemyers@aol.com Web: http://www.qsl.net/wa4usn/index.html

February 3-4

FL - MIAMI - Southeastern Division Convention. Fair Expo Center, 10901 SW 24th St. (Coral Way). Dade Radio Club, Evelyn Gauzens W4WYR, 305-642-4139. Email: w4wyr@arrl.net
Web: http://www.hamboree.org

February 4

OH - LORAIN - Hamfest. Gargus Hall, 1965 N. Ridge Rd. 8am-1pm. Talk-in: 143.700- and 444.800+. Northern OH ARS, John Schaaf K8JWS, 216-696-5709. Email: noars@qsl.net
TX - GEORGETOWN - Hamfest. Williamson County ARC, Mike Evans KD5AAD, Email: mlevans@mail.utexas.edu

February 5

AZ - PHOENIX - Auction. St. Clement of Rome Catholic Church Social Hall, 15800 Del Webb Blvd. Talk-in: 147.30+. West Valley ARC, Ron K6OP, 623-546-5710. Email: ronk6op@juno.com

February 9-10-11

FL - ORLANDO - Northern FL Section Convention. Central Florida Fairgrounds, 4603 W. Colonial Dr. Exams. Talk-in: 146.760 down 600, 145.110 down 600. Orlando ARC, Ken Christenson AF4ZI, 407-291-2465. Email: kd4jqr@juno.com
Web: http://www.oarc.org/hamcat.html

February 10

MI - TRAVERSE CITY - Hamfest. Cherryland ARC, Joe Novak W8TVT, 231-947-8555
TX - CANYON - Hamfest. Cole Community Center, 300 16th St. Potter/Randall County ARES/RACES, Ben Pollard WS5R, 806-381-8810. Email: ws5r@arrl.net
Web: http://www.qsl.net/nwtx-ares

February 10-11

TN - MEMPHIS - Convention. Shelby Co. Bldg., Mid-south Fairgrounds. Sat: 9am-5pm, Sun: 9am-2pm. Dixie Fest Committee, Ben Troughton KU4AW, 901-372-8031. Email: ku4aw@arrl.net
Web: http://www.dixiefest.org

February 11

OH - MANSFIELD - Hamfest. InterCity ARC & MASER, Dean Wrasse KB8MG, 419-522-9893. Email: deanwrasse@yahoo.com
Web: http://www.maser.org

February 16-17

OK - TULSA - Hamfest. Jones/Riverside Airport. Talk-in: 145.11 -600, 443.850 + 5MHz PL 88.5. Green Country Hamfest Committee, Merlin Griffin WB5OSM, 918-622-2277. Email: megriffin@ionet.net
http://www.greencountryhamfest.org

February 17

CA - MONTEREY - Hamfest. Naval Postgraduate School ARC, Max Cornell K0MC, 831-883-0491. Email: cornell@redshift.com Web: http://k6ly.org/radiofest
FL - SEBRING - Hamfest. Highlands County ARC, Darrell Koranda KB4XJ, 863-471-0226. Email: kb4xj@strato.net
MA - MARLBOROUGH - Hamfest. Algonquin ARC, Ann Weldon KA1PON, 508-481-4988. Email: annweldon@aol.com
OR - RICKREALL - Hamfair. Polk County Fairgrounds, 520 S. Pacific Hwy. W. 9am-3pm. Talk-in: 146.46. Salem Repeater Assn., & OR Coast Emergency Repeater, Dick Smith KK7OX, 541-997-4074. Email: kk7ox@presys.com
Web: http://repeater.homepage.com
TX - SMITHVILLE - Hamfest. Bastrop County ARC, John Creamer W5QXH, 512-321-1145

February 18

CO - BRIGHTON - Hamfest. Aurora Repeater Assn., Wayne Heinen N0POH, 303-699-6335. Email: n0poh@arrl.net
Web: http://www.qsl.net/n0ara
MI - FARMINGTON HILLS - Hamfest. William Costick Activity Center, 28600 W. 11 Mile Rd. 8am-1:30pm. LARC, 734-261-5486. Email: swap@larc.mi.org
Web: http://larc.mi.org
NY - WILLIAMSVILLE - Hamfest. Main Transit Fire Hall, 6777 Main St. Talk-in: 147.255. Lancaster ARC, Luke Calianno N2GDU, 716-634-4667 or 716-683-8880. Email: luke@towncountryflorist.com Web: http://hamgate1.sunyerie.edu/~larc

February 24

GA - DALTON - Hamfest. Dalton ARC, Harold Jones N4BD, email: n4bd@ocsonline.com
IN - LA PORTE - Hamfest. La Porte Civic Auditorium, 1001 Ridge St. 7am-1pm. LPARC, Neil Straub WZ9N, 219-324-7525. Email: nstraub@niia.net Web: www.geocities.com/k9jsi/
ND - BISMARCK - Hamfest. Central Dakota ARC, Kurt Carufel KB0KDG, 701-222-0938. Email: carufel@home.com
NY - HORSEHEADS - Hamfest. The National Guard Armory, Colonial Dr. 8am-3pm. FCC exams. Talk-in: 146.700-, 444.20. ARAST, Barry Gabriel N2EUS, 607-737-0626. Email: winterfest@arast.org
Web: http://www.arast.org
VT - MILTON - Hamfest & State Convention. Milton High School, Rt. 7. 8am-1pm. VE exams. Talk-in: 145.15. Radio Amateurs of Northern VT, Mitch Stern W1SJ, 802-879-6589. Email: w1sj@arrl.net
Web: http://www.ranv.together.com

February 25

NY - HICKSVILLE - Hamfest. Levittown Hall, 201 Levittown Pkwy. Talk-in: 146.850 PL 136.5. Long Island Moble ARC, Eddie Muro KC2AYC, 516-520-9311. Email: hamfest@limarc.org
Web: http://www.limarc.org

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http://www.agishows.com

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Web: ncshows.com

Peter Trapp Computer Shows
603-272-5008
Web: www.petertrapp.com

OH - CINCINNATI - Hamfest. Hartwell Recreation Center, May St. off Caldwell Dr. 9am-4pm. ARPSC, 513-661-1805. Email: gldivision@juno.com
Web: www.arpsc.com
OH - CUYAHOGA FALLS - Hamfest. Emidio's Party Center, 48 E. Bath Rd. 8am-2pm. Cuyahoga Falls ARC, Inc., Carl Hervol, 330-497-7047. Email: carlh@voyager.net
PA - CASTLE SHANNON - Hamfest. Wireless Assn. of South Hills, Steve Lane W3SRL, 412-341-1043. Email: washarc@yahoo.com Web: http://www.washarc.org/washfesty2k.htm
VA - ANNANDALE - Hamfest. Northern VA Community College, 8333 Little River Turnpike. VE exams. Talk-in: 146.31/91. Vienna Wireless Society, Mike Toia K3MT, 703-757-7021. Email: k3mt@erols.com
Web: http://winterfest.home.att.net

MARCH 2001

March 2-3

FL - NEW PORT RICHEY - Hamfest. Fred K. Marchman Technical Education Center, 7825 Campus Dr. 8am-5pm. Talk-in: 146.670. Gulf Coast ARC, Rick Brown KF4GXS, 727-863-1457. Email: richar@gte.net. Web: http://gcarc.cjb.net

March 3

AR - RUSSELLVILLE - Hamfest. Hughes Community Center, Knoxville & Parkway. 8am-4pm. Talk-in: 146.820. AR River Valley AR Foundation, Margaret Alexander KC5MCS, 501-968-7270. Email: ealexand@cswnet.com Web: http://www.cswnet/com/~arvarf/hamfest.htm
CA - REDDING - Hamfest. Shasta Cascade ARS, Jim Bremer KE6OUA, email: ke6oua@aol.com
IA - COUNCIL BLUFFS - Hamfest. Southwest Iowa ARC, Rich Swig WA0ZQG, 712-256-7775. Email: wa0zqg@arrl.net
KY - CAVE CITY - Hamfest. Mammoth Cave ARC, Marty Edwards KC4BFF, 270-528-2447. Email: medwar@scrtc.com
Web: http://www.scrtc.blue.net/mcarc
NJ - PARSIPPANY - Hamfest. PAL Bldg., 33 Baldwin Rd. VE session. Talk-in: 146.985-PL 131.8. Splitrock ARA, Peter Glenn KC2KI, 973-442-0772 or 888-511 SARA. Email: splitrock@worldnet.att.net
Web: http://ham.hsix.com/sara
OK - ELK CITY - Hamfest. West Central OK ARC, Earl Bottom N5NEB, 580-821-0633. Email: n5neb@logixonline.net

March 4

NY - LINDENHURST - Hamfest. Knights of Columbus Hall, 400 S. Broadway. 9am-2pm. VE exams. GSBARC & SCRC, Phil Lewis N2MUN, 631-226-0698. Email: info@gsbarc.org
Web: http://www.gsbarc.org

March 10

AR - HARRISON - Hamfest. Harrison Junior High School Cafeteria, 515 S. Pine St. 8am-1pm. VE testing. North Arkansas ARS, Bill Rose N5VKF, 870-741-6968. Email: billrose@cswnet.com Web: http://www.qsl.net/naars
AZ - SCOTTSDALE - Hamfest. Scottsdale

Events CALENDAR

ARC, Roger Cahoon KB7ZWI, 480-948-1824 home, 602-725-7256 mobile. Email: rgcahoon@uswest.net
CA - LINDA - Hamfest. Yuba-Sutter ARC, Ron Murdock W6KJ, 530-674-8533
TN - KNOXVILLE - Hamfest. Kerbela Temple, 315 Mimosa Ave. 8am-4pm. Talk-in: 144.83T/145.43R or 146.52 simplex. Kerbela ARS, Paul Baird K3PB, 865-986-9562
WA - PUYALLUP - Hamfest. Mike & Key ARC, Michael Dinkelman N7WA, 425-867-4797. Email: mwdink@eskimo.com

March 10-11

NC - CHARLOTTE - Hamfest & ComputerFair. Charlotte Merchandise Mart, 2500 E. Independence Blvd. The Mecklenburg ARS, Tom Hunt KA3VVJ, 704-948-7373 day & eves. until 9pm EST. Email: dealers@w4bfb.org Web: www.w4bfb.org/hamfest.html

March 11

MA - AMHERST - Hamfest. Regional Middle School, 170 Chestnut St. Talk-in: 146.94- no PL. MTARA, Cindy Loiero K1ISS, 413-568-1175. Email: n1fi@arrl.net

March 17

CT - POMFRET - Hamfest. Eastern Connecticut ARA, Paul Rollinson KE1LI, 860-928-2456. Email: kelli@arrl.net
FL - FT. WALTON BEACH - Hamfest. Playground ARC, Louis Carter KF4HRM, 850-243-4315. Email: parcfest@aol.com Web: http://www.bsc.net/playground/
FL - STUART - Hamfest. Martin County ARA, Romund Madson KS4KM, 561-337-1841
GA - MARIETTA - Hamfest. Kennehoochie ARC, Margaret Durham KB4QKW, 770-977-4405. Email: mjanewalls@aol.com Web: http://qsl.asti.com/hootch/karc-hamf_html
MI - MARSHALL - Hamfest. Southern MI ARS & Marshall High School Photo Electronics Club, Jim Holloway KG8GZ, 616-963-6602
WV - CHARLESTON - Hamfest. William H. (Jack) Kibler, Jr. K8WMX, 304-722-3150. Email: k8wmx@juno.com

March 17-18

LA - RAYNE - Hamfest. Acadiana ARA, L. "Al" Oubre K5DPG, 337-367-3901. Email: k5dpg@arrl.net Web: http://www.acadian.net/w5ddl
TX - MIDLAND - State Convention. Midland County Exhibit Bldg. Sat: 8am-5pm, Sun: 8am-2pm. VE exams. Midland ARC, Pete Stull WB7AMP, 915-686-6755 or 915-362-6644, email: W5QGG@arrl.net Larry Nix email: oilman29@home.com Web: http://www.w5qgg.org/

March 18

IL - STERLING - Hamfest. Sterling-Rock Falls ARS, Lloyd Sherman KB9APW, 815-336-2434. Email: lsherman@essex1.com
OH - MAUMEE - Hamfest. Lucas County Recreation Center, 2901 Key St. 8am-2pm. Talk-in: 147.27+. TMRA, Paul Hanslik N8XDB, 419-385-5056. Web: www.tmrahamradio.org
WI - JEFFERSON - Hamfest. Tri-County ARC, John Satterlee WA9SAB, 920-563-6381 eves. Email: tricountyarc@globaldialog.com

March 24

CANADA - ONTARIO - BRAMPTON - Hamfest. Peel and Mississuaga ARCs, Michael Brickell VE3TKI, 905-826-5176. Email: ve3tki@rac.ca
MN - ST. PAUL - Hamfest. Concordia University, Ganglehoff Center, 235 Hamline Ave. 8:30am-3pm. VE testing. Robbinsdale ARC, Harriet Johanson KB0UPH, 763-537-1722. Email: k0ltc@visi.com Web: http://www.visi.com/~k0ltc
WV - BECKLEY - Hamfest. Plateau ARA & Black Diamond ARC, James Martin KC8JSZ, 304-465-1428. Email: w373@inetone.net

March 24-25

FL - SARASOTA - Show. Sarasota Municipal Auditorium, 801 N. Tamiami Trl. Frank Cox 941-954-0202

March 25

IL - GRAYSLAKE - Hamfest. Lake County Fairgrounds. VE testing. Talk-in: 146.52 simplex. North Shore RC, Jacob Fishman KF9ZF, 847-291-4160. Email: kf9zf@arrl.net Web: http://www.ns9rc.org
NC - KINSTON - Hamfest. Down East Hamfest Assn., Doug Burt W4OFO, 252-524-5724. Email: jeanhd@icomnet.com
OH - MADISON - Hamfest. Lake County ARA, Roxanne N8BC, 440-209-8953 (9am to 9pm). Email: tbrown@ncweb.com Web: http://hamradio.org/lcara
PA - MONROEVILLE - Hamfest. Palace Inn. 8:30am-3pm. Two Rivers ARC, Roxane Gaal WB3ROX, 412-823-6613. Email: gaal@pgh.net Web: http://www.qsl.net/w3oc/hamfest.htm

March 30-31

NE - NORFOLK - Convention. Northeast Community College Lifelong Learning Center, 801 E. Benjamin Ave. VE testing. Talk-in: 146.730-. Elkhorn Valley ARC, Sam Seikaly WA6BRE, 402-379-4073. Email: sseikaly@conpoint.com Web: http://www.qsl.net/evarc/

March 31

CT - WATERFORD - Auction. Waterford Senior Center, Rt. 85. Talk-in: 146.730-. RASON, Mark Noe KE1IU, 860-536-9633. Bruce Adams KA1ZMZ, 860-886-1837. Email: badams01@aol.com Web: http://www.rason.org
KY - ELIZABETHTOWN - Hamfest. Lincoln Trail ARC, Leon Priest N4TFK, 270-351-4721. Email: n4tfk@qsl.net Web: http://www.qsl.net/w4bej
TX - BRENHAM - Hamfest. Brenham ARC, Dan Lakenmacher N5UNU, 979-836-8739. Email: lindan@pointcom.net Web: http://www.alpha1.net/~barc

March 31-April 1

MD - TIMONIUM - Greater Baltimore Hamboree & Computerfest/MD State ARRL Convention. Timonium Fairgrounds, York Rd. Baltimore ARC, Sharon Dobson N3QQC, 410-HAM-FEST or 800-HAM-FEST. Email: k3duh@amsat.org Web: http://www.gbhc.org

APRIL 2001

April 1

Events CALENDAR

CT - SOUTHINGTON - Hamfest. Southington ARA, Chet Bacon KA1ILH, 860-628-9346. Email: ka1ilh@chetbacon.com Web: http://www.chetbacon.com/sara/htm

April 6-7

WI - MILWAUKEE - AES Superfest 2001. Amateur Electronic Supply, Ray Grenier K9KHW, email: rayk9khw@aol.com

April 7

IN - COLUMBUS - Hamfest. Bartholomew County 4H Fairgrounds, Community Bldg., State Rd 11. 8am-2pm. Talk-in: 146.790/146.190. Columbus ARC, Marion Winterberg WD9HTN, 812-342-4670. Email: carc_in@yahoo.com
MO - LEBANON - Hamfest. Lebanon ARC, Chuck Sears AA0RK, 417-589-8122. Email: freedom1@advertisnet.com

April 8

NC - RALEIGH - Hamfest. Raleigh ARS, Chuck Littlewood K4HF, 919-872-6555. Email: k4hf@arrl.net
Web: http://www.rars.org
WI - STOUGHTON - Hamfest. Mandt Community Center, Stoughton Junior Fairgrounds. Talk-in: 147.150. Madison Area Repeater Assn., Paul Toussaint N9VWH, 608-245-8890.
Email: n9vwh@arrl.net
Web: http://www.qsl.net/mara/

April 21

FL - TAMPA - Hamfest. Tampa ARC, Biff Craine K4LAW, 813-265-4812.
Email: k4law@arrl.net
Web: http://www.hamclub.org
NC - MORANTON - Hamfest. Burke Co. Fairgrounds. Talk-in: 146.745. Catawba Valley, Tom 828-433-6205, Larry: af4hx@worldnet.att.net
OH - COALTON - Hamfest. Jackson County ARC, Edgar Dempsey KD8XL, 740-286-3239. Email: kd8xl@ohiohills.com
VA - CHESAPEAKE - Hamfest. Chesapeake ARS, Richard Siff WA4BUE, email: melody@pilot.infi.net

April 28

SC - WINDSOR - Hamfest. Salkehatchie ARS, Adam Hoffman AF4QZ, 803-245-4673. Email: af4qz@arrl.net Web: http://www.qsl.net/kf4cvo

April 29

IL - ARTHUR - Hamfest. Moultrie/Douglas County Fairgrounds. 8am-1pm. Talk-in: 146.055/146.655 and 449.275/444.275. Moultrie ARK, Ralph Zancha WC9V, 217-543-2178 days or 217-873-5287 eves. Email: rzancha@one-eleven.net
OH - ATHENS - Hamfest. Athens County ARA, Drew McDaniel W8MHV, 740-592-2106. Email: dmcdaniel1@ohiou.edu
OH - CANFIELD - Hamfest. Twenty Over Nine Radio Club, Don Stoddard N8LNE, 330-793-7072. Email: n8lne1@juno.com
PA - WASHINGTON - Hamfest. Washington Amateur Communications Club, Jim Burtoft KC3HW, 724-228-0546. Email: jbur@mlynk.com

MAY 2001

May 5

AZ - SIERRA VISTA - Hamfest. Cochise ARA, Robert Warren KF7TJ, 520-803-1453. Email: warnel@juno.com Web: http://www.qsl.net/k7rdg
SC - GREENVILLE - Hamfest. Blue Ridge ARS, Bob Watson W4RGW, 864-833-2204. Email: w4rgw@arrl.net Web: http://www.brars.org
WI - CEDARBURG - Hamfest. Ozaukee Radio Club, Gene Szudrowitz KB9VJP, 262-377-6792. Email: szudg@msn.com

May 5-6

AL - BIRMINGHAM - Hamfest. Zamora Temple. Sat: 9am-5pm, Sun: 9am-4pm. FCC exams. Talk-in: 146.88. BARC, Glenn Glass KE4YZK, 205-681-5019.
Email: ke4yzk@bellsouth.net
Web: http://www.w4cue.com
TX - ABILENE - West TX State Convention. Key City ARC, Peggy Richard KA4UPA, 915-672-8889. Email: ka4upa@arrl.net Web: http://www.angelfire.com/tx/kcarc76/hamfest.html

May 6

MD - HAGERSTOWN - Hamfest. Washington County Agricultural Center. VEC exams. Talk-in: 147.090. Antietam Radio Assn., Carl Morris WN3DUG, 717-267-3411. Email: morriscw@cvn.net Web: http://www.qsl.net/w3cwc
NY - YONKERS - Flea Market. Lincoln High School, Kneeland Ave. 9am-3pm. VE Exams. Talk-in: 440.425 PL 156.7, 223.760 PL 67.0, 146.910, 443.350 PL 156.7. Metro 70cm Network, Otto Supliski WB2SLQ, 914-969-1053. Email: wb2slq@juno.com Web: http://www.metro70cmnetwork.com
PA - WRIGHTSTOWN - Hamfest. Middletown Grange Fairgrounds. VE testing. Talk-in: 147.09 and 443.950. Warminster ARC, Tony Simek N3YNH, 215-674-5218. Email: tsimek@aol.com Web: www.voicenet.com/~juno.com
WV - RIPLEY - Hamfest. Jackson County ARC, Valerie Hunter KC8PPT, 304-372-9518. Email: salamander54_25239@yahoo.com

May 12

OK - EUFAULA - Hamfest. Community Center, corner of High & First St. Talk-in: 146.955 -600, 144.250 USB. Lake Eufaula Hamfest, Mark Magreevy N5PNE, 918-689-5366. Email: n5pne@yahoo.com
Web: http://go.to/eufaulahamfest
WA - STANWOOD - Hamfest. Stanwood-Camano ARC, Dave Huppert KA7FDC, 360-387-6123. Email: huppert@whidbey.net

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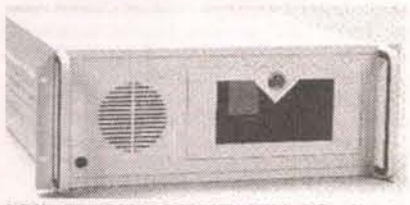

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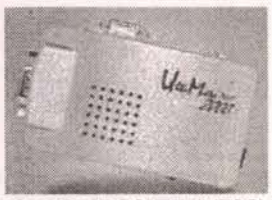

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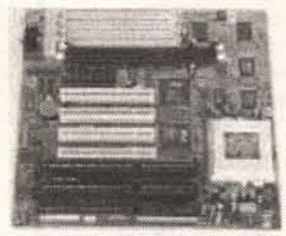

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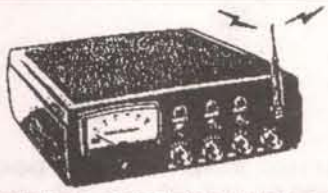

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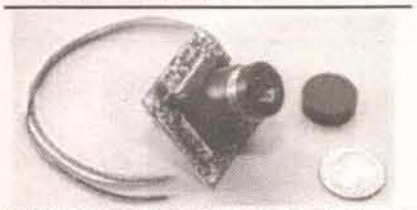

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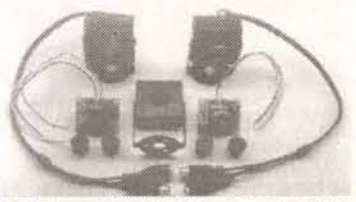

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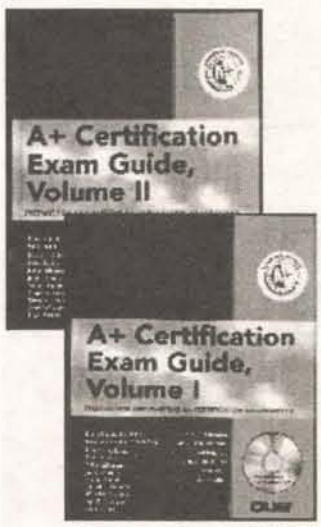

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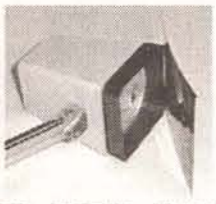

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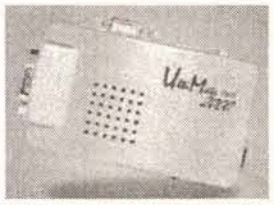

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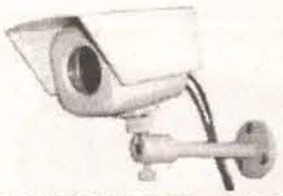

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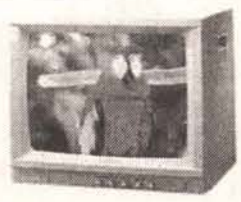

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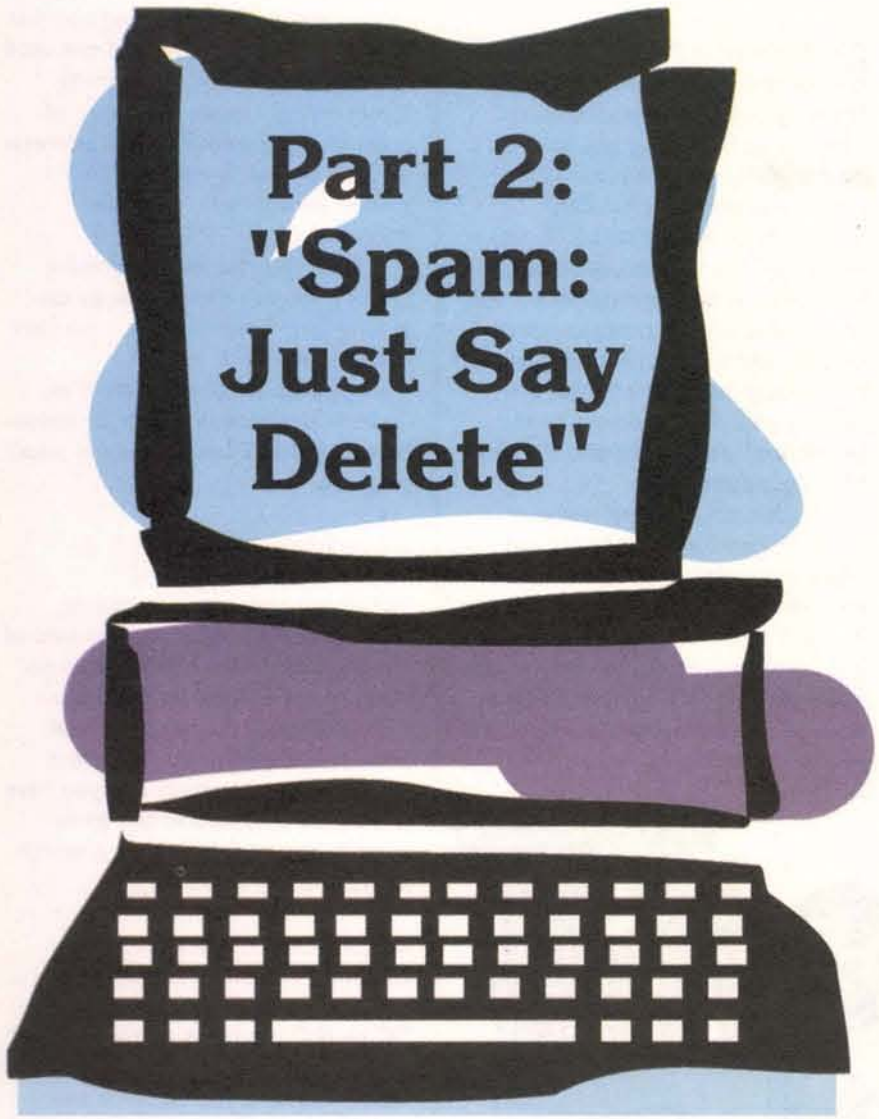
Continued on page 56

Cyber-Street Survival

by M L Shannon



In Part 1, we had a look at some of the ways your privacy is being invaded by marketing companies, a short look at the history of the Internet, and a few basic things you can do to make your Windows computer secure against invasion by "Hackers."

Then we covered some ideas about getting connected for the first time. If you weren't then, I hope you have since gone online. Now, on to Part 2, which is mainly about Spam.

Spam — The Scourge of the Internet

Unsolicited Commercial Email (UCE). Email that you did not ask for, and which is usually (but not always) about scams, rip-offs, fraud, chain letters, pornography, religious fanatics, or hate groups. People trying to separate you from your money if not your sanity.

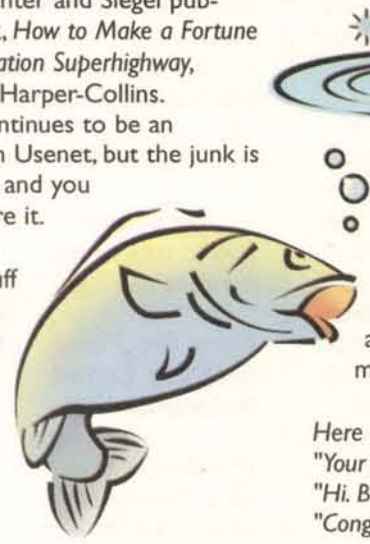
Here, we will look at some of the things you can do. Complain. Fight back. Track the spammers down. Raise hell. There are some good ideas here, some useful information on doing these things. And if you have both the time and the inclination, then have at it. But the easiest way is to just delete it.

Cyber Promotions and the Great Green Card Lottery

Spam had existed for some time on the Internet, but not on a massive scale until April of 1993, when two Arizona immigration attorneys — Laurence A. Canter and Martha S. Siegel — decided to make a mass mailing with an offer to help people register for the Green Card lottery. This was posted on hundreds of the newsgroups on Usenet (explained below) which the lawyers should have known is not well tolerated. The reaction was swift and it was extreme. Canter and Siegel were bombarded with complaints. So many that their ISP could not handle the traffic and was shut down, and their account was closed. They were also subjected to telephone harassment, and even threats of violence.

Later, Canter and Siegel published a book, *How to Make a Fortune on the Information Superhighway,* published by Harper-Collins.

Spam continues to be an annoyance on Usenet, but the junk is posted there and you can just ignore it. With private email, this stuff comes right to your mailbox, and so it has become a major problem. What Canter and Siegel did was nothing compared to the spammers of today. They build mailing lists or buy them from brokers, then open an account at an ISP somewhere, and use automated programs that mail their spam to hundreds of thousands of addresses in a short time. They set up toll free 1-800 numbers with recorded messages, where people can leave their credit card information, or a mail drop to send them checks and money orders. Then they sit back and wait for people to send them money. After a while, they close their post office boxes and Internet accounts, come up with a new scam, and set up somewhere else.



Recognizing Spam

Spam by any other name would smell as rancid. With apologies to William Shakespeare, how can you tell if a particular message is spam? You can take the time to read it, but first, do you recognize the name of the person or company that sent it? Read the Subject line. If it says something like, "Make $500.00 per hour as a cucumber waxer" then it probably is spam. Anyone who has been around the Internet for very long will instantly recognize such hype. So, spammers come up with things that are more likely to get your attention; to get you to read the message.

Here is the information you requested."
"Your check is waiting."
"Hi. Been a while since we chatted … "
"Congratulations! You have just won …"

"This Is Not Spam" (The Hell it Ain't)

Some spammers will quote a "Federal law" claiming that what they are sending 'cannot be considered spam' because they offer you the option, called 'Opt-Out' of asking to be removed from their list. This was never enacted. It is not a law and it means nothing. Spam is spam.

For the latest information on this and other legislation that is introduced, check out www.spamlaws.com.

Well, Don't Answer Because You Also Get …

Many spam messages contain a statement something like: "If you received this message in error or do not want to be on this list, just enter 'delete me' in the subject line of your Email program and hit <Enter>. Not a good idea. Answering only verifies that your Email address is valid, so it will be used again, as well as sold to other marketing companies and information brokers.

So what you also get ... is more spam.

Complain

Spam complaints are generally a waste of time.

First of all, to whom do you complain? Spam is often sent through one or more relays; through servers who knows nothing about it, so complaining to them does no good and they have no responsibility to trace it. One spam I got was from a server in Japan, using a return address at Hotmail. Forwarding it to abuse@hotmail.com elicited the following response:

Thank you for writing to MSN Hotmail.

I appreciate your bringing this unsolicited Email message to our attention, but I can't take action against this person because the mail was sent from an outside source, not Hotmail.

Even if the complaint goes to the right server, all you are likely to get is an autoresponder — an automatically generated form letter advising that they do not permit spam, and will close the account of anyone sending it. This takes up more bandwidth and, of course, is more mail for you to delete. You have taken up your time to do something which accomplishes little, if anything. Why bother? If the account is closed, the spammers will just set up shop somewhere else.

Spam-timidation

Some spammers try to keep you from complaining. The following is from a post on the Usenet newsgroup alt.spam on 02 April 2000. It is in response to a complaint against a well-known spammer.

Your address is on our Opt-In list of people interested in business opportunities. If this is an error, please click on the following link:

mailto:removes3704@bigfoot.com?subject=DeleteMe4 I and you will be removed from our database. If you don't use "remove" option and complain to any ISP, that's entrapment. Remember, you had the option to click on link above !!!

We send all flamers, hackers, and people using vulgar language to the FBI and Interpol on a monthly basis.

We take legal action against people spreading worms/viruses through Email, as well as their ISPs.

Please be aware that any disruption to our remove link prevents those that want to be removed from our database from being removed. And that is illegal.

It is a felony to interfere with business activity by using phone lines across state lines.

—— End Forwarded Message ——

Pay no attention to such drivel, it means nothing.

How Do They Get My Email Address?

Spammers have sophisticated ways to get your Email address, and once it is on a list, there is little you can do to prevent it from being passed around to other spammers. So, let's look at some of the ways you might get on these lists, and how to avoid getting on others.

Web Browsers

Remember in Part I about how some web sites can extract your Email address from your browser? They do so by getting you to click on things. Netscape has an option where you can use your Email address as an anonymous FTP password. FTP is a method, another protocol used in transferring data. If you have your browser configured that way, then when you click on a particular button at a web site, you are sending your Email address to the people who set up that site. Gotcha! Not a good idea.

So, for safer surfing, use your browser only for the WWW, and when you install it, don't include your real name or Email address. Remember in Part I about Profiles? Just make up a name. For Email, consider using Eudora Light or Pegasus. Both of these programs are free and you can get them at

www.tucows.com.

Here is a site that will tell you about what your browser is revealing about you: http://www.privacy.net/analyze/.

Guest Books

Many web sites ask you to sign a guest book and sometimes fill in a questionnaire. In most cases, this is probably harmless — it will get you on their mailing list, but your name will not be sold or given to spammers. But there is no guarantee. The choice is yours.

Posts on Usenet

Usenet is a collection of forums or discussion areas, called Newsgroups. There are groups for any subject you can imagine. Thousands of them. If you have not yet experienced Usenet, you can do so with a program, called Free Agent, which you can download at www.tucows.com. It is easy to set up; install it as you would any other program and follow the directions. In the process, you are required to enter an Email address. If you use your real one, it will be picked up by robots that scan Usenet and compile what they find into lists that are used for spamming. While researching Cyber-Street, I made a number of posts using several one time addresses. Sure enough, a few days later, I started getting spam to those addresses.

So, if you plan on frequenting Usenet, you can avoid spam by disguising your Email address, a process called 'munging.' If you are 'louie@thisplace.com,' enter it as 'louie at thisplace dot com' or something like that. Then the robots won't snag you.

Deja News

This is a web site that, among other things, archives gazillions of messages that have been posted on many of the Usenet newsgroups. And, of course, the posters Email addresses. Including yours. Unless you munged (disguised) it. If you have posted on Usenet, you can go to www.dejanews.com and do a search for your Email address.

Chat Rooms on the Internet Relay Chat

The IRC is a place on the Internet — actually there are many of them — where you can type messages back and forth with other users in real time. There are private areas, rooms, and public rooms or forums, and some of them get very personal. It is here that sometimes personal meetings are arranged. We'll get into IRC in Part 5, on hacking. For now, please be aware that IRC can be a dangerous place to be if you don't know what you are doing. But if you are anxious to experience IRC, I hope you will consider visiting CyberAngels at http://cyberangels.org.master.com and do a search for IRC. Also, backup any important files.

Servers

All Service Providers have to maintain a list of their customer's Email addresses. This is not accessible to the public, but a person with the right skills may be able to get to it and make copies. This happened at one of the largest servers a couple years ago; thousands of users had their addresses copied. And, by using a little known trick — "Fingering the Gateway" — it is possible to get lists of people who are logged on to some servers. You can read more about this in Part 6

Internet Tools.

And ...

You go to a supermarket and they offer you one of those plastic cards, for which you are required to fill in an application. Including your Email address. It is very thoughtful of the produce manager to let you know when artichokes are on sale, but do you have any guarantee that the supermarket isn't going to pass your address on to a broker? No.

Having purchased the makings of your dinner, you stop by the Post Office to collect your mail and on the sidewalk is a brand new 12 cylinder BelchFire convertible wrapped up in ribbons. A dozen enthusiastic young people in pink coveralls are running round, trying to get passers-by to enter the free drawing to win this flashy gas guzzler. And on the entry form you are required to enter your Email address. Now why do you suppose they want it? To notify you when you win? Give them your Post Office box number. It's getting to where every place you go, everything you do, someone wants to send you Email.

Email addresses are copied from web sites, Yellow Pages ads, business cards, posters in subway stations. Anywhere they appear, they get harvested.

They Got Me. Now What Do I Do?

If you have Email, then there is no way to completely avoid spam. Maybe only one or two a week, if you are lucky. I get 10 to 15 a day. But most of them are never seen because they instantly 'disappear.'

Filters

Most Email programs have filters that will automatically transfer junk mail to a separate file such as Trash, or whatever you want to name it. Be careful with them. They will sometimes transfer legitimate mail, so it is a good idea to look through these other boxes, just in case something you wanted ends up there. But all things considered, if used right, they will free you from having to read much of what you get. I use this filter to block free Email sites such as Bigfoot.com since they are the return addresses frequently used in the spam I get. I have many of them archived on a CD.

Get a New Address

Being spammed is a little like being stalked, which we will talk about later in this series. If someone is making threatening telephone calls, you can change to an unlisted number and give it to only people you know and trust. And you can do the same with Email. Usually, this isn't necessary unless you are being literally deluged with spam. But, it is your choice. There are dozens of free "Email For Life" sites to choose from. However, unless you are really freaked out, you might wait to read Part 3 which is mostly about Email.

What Not To Do

Dig around and you will learn about Mail Bombs, which flood any Email address with thousands of copies of the same message. Not a good idea, since they use up bandwidth and further jam the net, and also may be unlawful. And, of course, you are placing a load on the spammers ISP which isn't fair to them.

Free Lottery Tickets

One suggestion I saw on Usenet was to make up a batch of adhesive labels that say, "Free Lottery Tickets" and list the spammers toll free number, and then place them on pay telephones.

Let Someone Else Do It: Not!

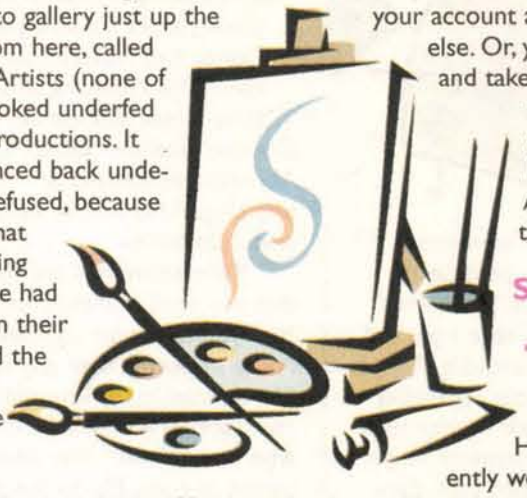
What Cyber-Street Survival is all about is doing it yourself. Learning what you need in order to make your own decisions on how to deal with spam. Taking control of your own computer rather than letting someone else make your decisions for you.

As you read above, some spammers claim that what they send is not spam because of a "Federal law." And while there is, as of this writing, no such law, one day there may be. Meanwhile, there are those who offer to help you deal with spam. Some are altruistic; they really want to help and provide a great deal of useful information. But others are taking away your choice and doing things that you are not advised of. Here is one example.

Starving Artists and Self-Appointed Mail Blockers

Experienced spammers know how to forward their junk through some ISPs, called 'open relays' making it more difficult to trace. And because of this, sometimes people do not receive their legitimate Email. Your Granny in Iowa sends you an electronic Happy-Cyberthday card but you don't get it because, unknown to you, it was blocked. By someone you never even heard of. Granny is unhappy since you didn't thank her. Next Thanksgiving, she will be very cool toward you. And you will not get a drumstick.

A few months ago, I sent Email to a photo gallery just up the street from here, called Starving Artists (none of whom looked underfed to me) Productions. It was bounced back undelivered, refused, because the ISP that the starving artists use had my ISP on their list, called the Realtime Blackhole List or RBL.



In other words, the ISP where I have my account (Istep Communications) was on this 'blacklist' because Istep had at some time apparently been used as a relay — even though the technicians at Istep knew nothing about this. So, I was prevented from sending Email to the starving artists.

The starving artists didn't know anything about this; they didn't know that their ISP was blocking some of their Email until I walked up there and talked to them. When they opened their account at their ISP, they weren't advised that this could happen. No one explained it to them. They have since closed their account and moved to a different server.

This RBL is maintained by MAPS, the Mail Abuse Prevention System, and is operated by a (expletives deleted) self-appointed "guardian" of the Email system who has a 'cause' and is apparently indifferent to the fact that sometimes legitimate Email is not being delivered.

Now, eventually you and Granny will make up, but suppose the mail that was blocked was a job offer? A purchase order?

What can you do about this? You can find out if your ISP is on the RBL list and, if so, consider closing your account and going somewhere else. Or, you can do nothing and take your chances. If you want to know more about MAPS, go to http://maps.vix.com/. Also, ask your ISP if they subscribe.

Spam Cop

This is a service which was established to fight spam. Here's how it apparently works:

You get spam. You send a copy of said spam to Spam Cop. Spam Cop acknowledges it. Then they send a copy to the ISP where the spammer has their account, if they can track it down. That ISP sends Email back to Spam Cop, as well as, I believe, two replies to you.

So where you originally had one message you didn't want, now you have three or four. And the total

messages generated from a single spam is now about seven. Seems like a waste of bandwidth to me, and remember that the vast majority of people on the Internet don't have DSL; they are using 56K modems, and all this extra traffic doesn't help on an already slow Internet.

Maybe Spam Cop will be successful in shutting down a spammer. But maybe said spammer will just open a new account at another server. Business as usual.

Spam Cop also can be useful in tracking spammers. More on this coming up.

Tracing Spammers

In Part 6, we will get into IP Tools; programs and techniques with which it is

sometimes possible to track down spammers. Sometimes. For now, let's apply a little logic and see what we can do without IP tools. Spam is invariably about separating you from some of your money, right? And if said spammer expects to get any of your hard earned cash, they have to provide you with a place, an address to send said cash. Or a phone number to call so you can use a credit card.

So look for phone numbers. Usually, they will be toll free and you will get a recorded message telling you to send the money to an address which more than likely will be a post-office box or mail drop.

But not always. I got a spam recently that had a local phone number. Okay, I keep harping about Just Say Delete, and while I believe it is the most effective answer to spam, there is nothing wrong with raising a little hell now and then to relieve the irritation of being spammed. So I called this number and had an interesting conversation punctuated with expletives and implications that spammers are directly descended from horse thieves and saloon girls.

Another spammer that was easy to track down was from a company that sells cellular telephone accessories. I logged on to Dogpile (www.dogpile.com) and did a search for the company name. I found that the Attorney General's office in Florida had received complaints about this company, and published their street address on Campus Drive in Newport Beach, CA. The AG web site address is: http://legal1.firn.edu/lit_ec.nsf/$defaultview?OpenView

If the spammers are requesting that you send money through the US Mail, you can make complaints to the Postal Inspector. If all you have is an 800 number, many licensed private investigators will be able to find out who owns them. I may post the names of a few PIs on the message board I have set up on my site, www.fusionsites.com.

This is the easy way. Tracking down spammers through the Internet is no trivial task. One place to start is Spam Cop.

Spam Cop Revisited

A free service available at Spam Cop traces the addresses in the headers of Email. The header is a series of lines of text that include the various servers the message has passed through, including relays and other information. The header is not normally visible in the mail you get; you have to do something to see it. With Eudora, click on the little button that says Blah Blah Blah. For other Email programs, go to http://spamcop.net/fom-serve/cache/19.html for detailed instructions.

Here is an example of a header, a short message I sent to myself:

1. X-Delivered: at request of (myself) on halfdome
2. Received: from glacierpoint.istep.com (glacierpoint.istep.com [216.200.201.12])
3. by halfdome.istep.com (8.8.5/8.8.5) with ESMTP id WAA22332
4. for <mls@fusionsites.com>; Fri, 29 Sep 2000 22:14:51 -0700

5. Received: from (myself) (dial04.istep.com [208.128.203.200])
6. by glacierpoint.istep.com (8.9.3/8.9.3/Debian/GNU) with SMTP id VAA03492
7. for <mls@fusionsites.com>; Fri, 29 Sep 2000 21:52:16 -0700
8. From: mls@fusionsites.com

Message-Id: <3.0.6.32.20000929221806.0081a580@mail.istep.com>
X-Sender: ——@mail.istep.com
X-Mailer: QUALCOMM Windows Eudora Light Version 3.0.6 (32)
Date: Fri, 29 Sep 2000 22:18:06 -0700
To: mls@fusionsites.com
Subject: Header demonstration
Mime-Version: 1.0
Content-Type: text/plain; charset="us-ascii"
X-UIDL: fa6c9691f82169bbcae671f1eaf7d1d9

The actual message: "This message is sent for the purpose of displaying Email message headers."

Confusing, eh? The first eight lines have only two addresses: Istep, which is my ISP, and Fusionsites which is my web site address which I use for (some) Email. That's what there should be, since the message went from this computer directly to my ISP, and directly back. No relays, and no MTAs (Message Transfer Agents). Try it yourself and you should see something similar; only two addresses ending in .com (or .net or .org).

A spam might have a header several times as long as it is passed through other servers along the way. And, of course, some of them may be relays. Ignore the rest of the header for now.

Tracing a spammer means finding which of these address lines is the real one. But, since they can be forged, as well as being relayed through servers without their knowledge, this can be difficult.

At Spam Cop, you can do an automated trace by copying the entire spam, including the header, and pasting it in the space provided. Go to www.spamcop.net. Read the Welcome paragraphs, and then click on 'Just Testing.' Here, you can try it out without actually making a complaint or sending Email to anyone.

Now, go back to your Email program, open the spam message and make sure the header is visible. Place the cursor somewhere within the message, hold down the <CTRL> key, and click 'A' to highlight the text, then 'C' to copy it.

Then go back to Spam Cop and

in the box under where it says "Paste entire spam here," click the cursor once to make sure it is blinking in the box and do <CTRL> 'V' to paste a copy of the spam. Next, check the box that says 'Verbose' and finally, click the Process Spam button.

Spam Cop churns away for a few seconds after which you will see many lines of text that are even more confusing. Just ignore it for now — this was only a test.

You may see a message pop up in a small box asking you if this really is spam. As you read above, a few spammers use their real contact information. In this case, it is still spam (if you didn't request it) but you get this question because there appears to not be any faked addresses or relays in the header.

Experiment with this if you like, trying different spams, and becoming familiar with the address lines. The first listing — the address at the very bottom — is where (unless disguised) the spam originated from. The top line will be the last hop the spam took in its journey to your mailbox. Thus, the bottom is the earliest, the oldest. After experimenting for a while, you might read the tutorial at http://samspade.org/ssw/ which will now be easier to understand.

Another excellent tutorial was written by Matthew Schneider, the programmer who produced Net Demon, which is a suite of Internet tools that will be useful in tracing spammers. It is being rewritten and the web address where you can read it will be posted in Part 3.

Some other interesting sites are:

http://www.rahul.net/falk/mailtrack101.html
http://home.wanadoo.nl/tcc/links/spam.html
http://www.whew.com/Spammers/

Sue the Bastards

There are those who advocate suing spammers in Small Claims Court. CAUCE, the Coalition Against Unsolicited Commercial Email at www.cauce.org is one. A great idea in theory, but in practice (as in the practice of law), it isn't quite so simple.

If you expect to win a lawsuit, you have to provide evidence to the court that you were somehow damaged.

An ISP can claim considerable damages since they are dealing with thousands of spams going through their system, and there has been one California case where an ISP sued a spammer and won. You can read about it at http://slashdot.org/articles/99/08/02/129213.shtml.

But, as an individual, how much damage could you have you incurred from one spam? Or even a dozen from the same person?

Sammy Spammer sends you an offer to buy a magic formula with which you can predict the winner of any horse race. You are a bit skeptical and don't reply, and he sends it again. So you decide to exercise your legal right and sue, get the forms, and pay the filing fee.

Now, you have to get service on Sammy. Have him served with a notice that he is being sued, and that if he does not appear in court, a default judgment will be entered against him. And this may be a problem. Suppose that Sammy isn't in the same state as you are. In some Small Claims courts, you can not get service on a person in a different state. You would have to file in Circuit or Superior Court, and unless you have a good working knowledge of civil litigation, you will need to pay an attorney to make the filing. And that will cost you a lot more than you are likely to win.

Next you have to prove that Sammy Spammer was, in fact, the one who sent you the spam.

Printed copies of the spam may be enough to convince the judge, and having a witness testify would be even better. If Sammy doesn't show up, the judge may well enter a default judgment, but the judge will also decide the amount of the judgment. What you get isn't necessarily what you ask for, especially if it is outrageous.

And finally, even if you win, a judgment is worthless if you can't collect it. This can be a complex process, with which you will need help, and there isn't space here to go into detail. Meanwhile, Sammy closes his Post Office box, shuts down his Internet connection, and sets up elsewhere. All that for nothing. Think about it. If this were really such a great idea, if people were really able to sue and collect their judgments that easily, the courts would be flooded with complaints just like the Internet is flooded with spam. But, they are not. Want to know more? Check out www.suespammers.org

The Last Word — Spam is Here to Stay

There are laws that restrict telephone solicitors, particularly those who use automatic dialers. But they keep calling. There are laws restricting unsolicited junk faxes. But you keep getting them. And every day, when the mail delivery person hands you a stack of envelopes, you start to think that maybe your name really is 'Occupant.'

Spam is a big problem, and as you have read so far, there are ways of dealing with it. But it is not realistic to think that you, or anyone else for that matter, can eliminate all of it from your mailbox.

And don't count on the government to help. So far, what they have done favors spammers. "Opt-Out" meaning spammers can send all the junk they want as long as they include real contact information you can use to tell them to stop. And even that is useless because they will run their scam for a while, and then start a new one with a different Email address.

Okay, you say, I will Just Say Delete. Does this mean that spammers will go away if they are ignored? This is debatable. Commercial advertisements in newspapers run for so many issues, but if they don't generate income, then the ads are canceled. Why should this be any different with spammers?

Eventually, if they start to discover that no one is sending them money, then they probably will go away. True, it is dirt cheap to send out thousands of spams, and it takes only a fraction of a percent to make it pay off, but it still isn't free. So if no one sends in their $14.95 for guaranteed winning lottery numbers (and people actually do), then the spammer will probably discontinue the scam. Maybe they will try another scam, but if this one also fizzles, maybe they will get the message.

Just Raise Hell!

While I believe in Just Say Delete, I do not mean to discourage anyone who wants to fight spammers. So, if you want to get involved, by all means do. Kick some binary butts.

Visit the Sam Spade site at www.samspade.org and read the tutorials on tracing spammers.

Many organizations are doing what they can to help, such as CAUCE and Spam Cop. The Electronic Frontier Foundation (www.eff.org) and the Electronic Privacy Information Center (www.epic.org) have useful information. Contact them. Get on their mailing lists (you can trust these people) and join forces with them. But, if you only want a peaceful existence on the Internet, then Just Say Delete. **NV**

Next Month:

What you need to know about Email, including ways to make it more secure, and a program with which you can explore the WWW anonymously. Without leaving a trace. This is A4proxy, which you can download at www.inetprivacy.com.

By all means, go ahead and download it without waiting for the next issue of *Nuts & Volts*. It isn't difficult to learn, and should you need help, check out the message board at www.fusionsites.com.

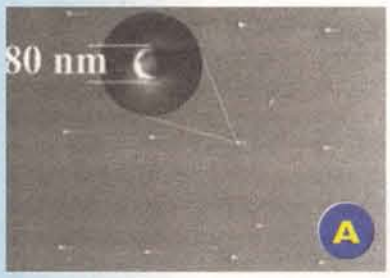
TechKnowledgey 2001

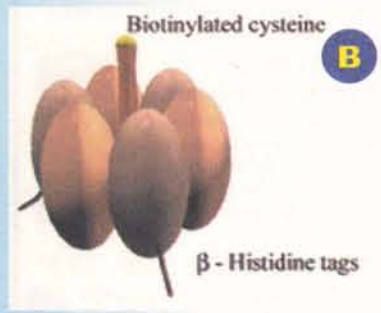
Events, Advances, and News From the Electronics World

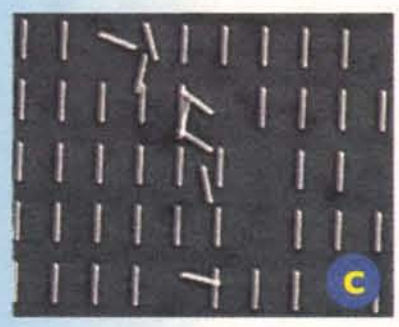
by Jeff Eckert

Advanced Technologies

Biomolecular Motors Use Propellers for Movement







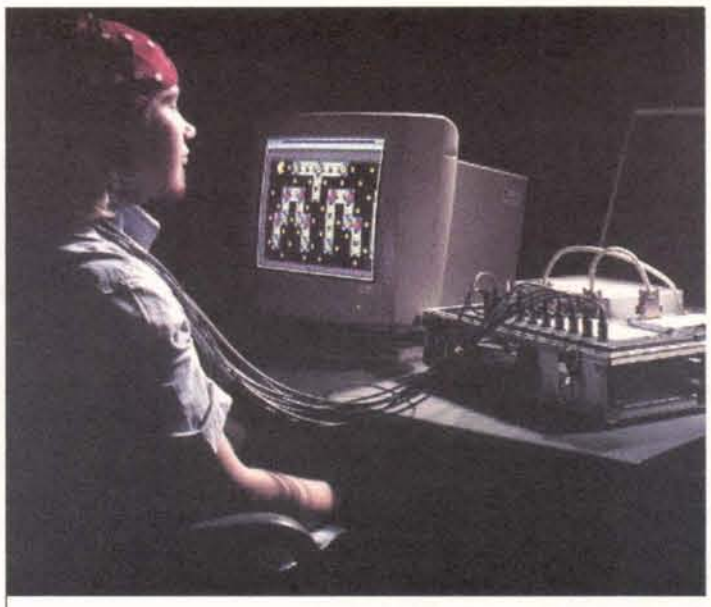
Details of the biomolecular motor with a nanofabricated propeller. (A) Electron microscope photo of nanofabricated nickel post, 80 nm wide and 200 nm tall. (B) Drawing of ATP biomolecular motor. (C) Electron microscope photo of nanofabricated nickel propellers, 750 nm long and 150 nm in diameter. (D) Drawing of a nickel propeller attached to assembled biomolecular motor, perched atop a nickel post. Courtesy of Montemagno Research Group and Science magazine, © 2000.

Nanobiotechnologists at Cornell University have reported the successful construction and test of a biomolecular motor with tiny metal propellers attached. The devices are built on the "nano" scale, where a nanometer equals one billionth of a meter. This is essentially in the realm of viruses, which range from about 17 to 1000 nm wide. The motors are powered by an adenosine triphosphate (ATP) enzyme and rotate at eight revolutions per second. The nickel propellers, which are about 750 nm long by 150 nm in diameter, were built using a sequence of techniques that include electron gun evaporation, electron beam lithography, and isotropic etching.

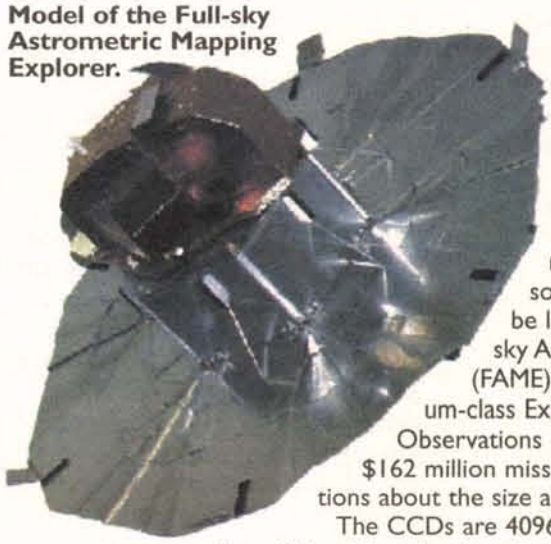
Said to represent a new generation of nanotechnology, these nanomotors are intended for use as tiny medical devices that move around inside the body and act as "nanonurses." In such applications, they might detect chemical signals from body cells, calculate a proper drug dosage, and administer the drug from within. In tests at Cornell, 400 of the motors were immersed in a solution of ATP and other chemicals, and functional units spun their propellers for 2.5 hours. Unfortunately, only five of the 400 units worked properly. Some of the propellers came loose and flew off, and some of the motors failed for a variety of reasons. Nevertheless, the researchers expect to improve on this and to develop models that run on photons instead of ATP. They also plan to add computational and sensing capabilities to the devices that will allow them to self-assemble inside human cells. A technical paper on the construction of nanomechanical devices is available at **www.foresight.org/Conferences/MNT6/Papers/Montemagno/index.html.**

Progress in Making Brain-to-Computer Connection

In recent years, researchers around the world have been trying to create a practical link from the human brain to a computer, generally referred to as an "adaptive brain interface" (ABI). While still in a primitive stage, some progress has been reported by the Joint Research Centre of the European Commission. The concept involves the use of electroencephalogram (EEG) signals to generate specific commands. For example, the human subject might learn to adjust his mind to five different mental states that correspond to up, down, right, left, and choose on a computer screen. In this manner, he could move a cursor around a diagram of a keyboard and type a message. In recent experiments, subjects wearing an EEG helmet have been able to control their thoughts well enough to generate signal recognition rates of about 70 percent. The process requires about one second for each decision and recognition cycle, which in tests has translated into the ability to type only a few characters per minute. However, expected improvements in the process could make it extremely useful for disabled people. Researchers are also exploring the possibilities of using the concept for playing computer games and for controlling robots, wheelchairs, and other electromechanical devices. Details are available at **http://esba-www.jrc.it/sba/esprit/abi-esprit.htm.**



Charge-Coupled Devices Help Map the Near Universe



Model of the Full-sky Astrometric Mapping Explorer.

Scientific Imaging Technologies, Inc. (SITe) **(www.site-inc.com)**, has been awarded a contract to supply 56 charge-coupled devices (CCDs) for a space telescope that will map 40 million stars and search for new planets outside our solar system. The mission, to be launched in 2004, is the Full-sky Astrometric Mapping Explorer (FAME), a part of the NASA medium-class Explorer (MIDEX) program. Observations made during this five-year, $162 million mission could help resolve questions about the size and age of the universe.

The CCDs are 4096 x 2048 pixel, 15 µm devices that will be thinned and configured with an anti-reflective coating at SITe's newly constructed six-inch thinning facility in Tigard, OR. The CCDs produce high-resolution images by turning light into a stream of electronic signals that can be recorded, analyzed, and displayed. SITe's CCD technology incorporates a patented process for thinning and strengthening the silicon substrate to accommodate the back-illumination of the CCD pixels, a process that yields devices with very high quantum efficiency at wavelengths from near infrared to ultraviolet.

The FAME astrometric satellite is designed to be a small, low-cost survey instrument for accurately determining the positions, distances, and motions of 40 million stars within our galactic neighborhood. The telescope will measure stellar positions to less than 50 microarcseconds. To put this in perspective, the width of a typical strand of human hair would subtend 50 microarcseconds when viewed from a distance of 130 to 190 miles. FAME is a collaborative effort between the U.S. Naval Observatory, Lockheed Martin Space Systems Company, the Naval Research Laboratory, and the Smithsonian Astrophysical Observatory.

Missile Technology Applied to Treatment of Breast Cancer

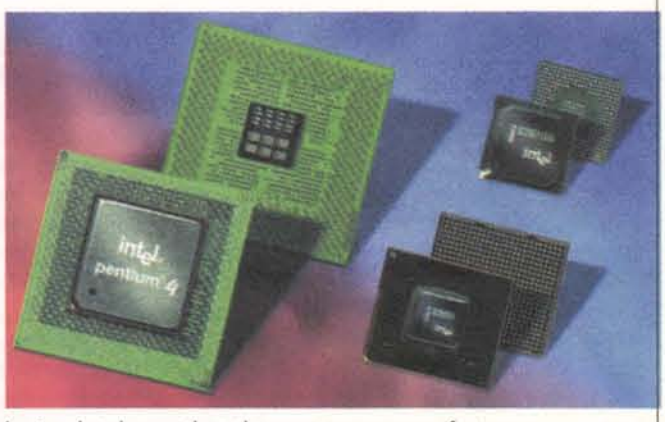
A Massachusetts Institute of Technology (MIT) researcher's work on radar technology to detect missiles will be applied in Food and Drug Administration (FDA) approved Phase II clinical trials for the treatment of breast cancer. A Phase I clinical trial was completed in July 2000. In the Phase II trials, more than 100 women will receive focused microwave thermotherapy to heat breast cancer cells to about 115 degrees Fahrenheit, killing them. The treatment is an out-patient procedure, and patients go home with only one or two small bandages.

According to Dr. Alan J. Fenn, a senior staff member in the Air Defense Technology Division of MIT's Lincoln Laboratory, "About 10 years ago, we were working on radar anti-jamming technology to detect missiles from space-borne satellites. In the Strategic Defense Initiative, the main objective was to develop concepts and technology to quickly detect a missile launch, then destroy the missile over the enemy's territory as a deterrent. As the Cold War was ending and we were asked to look for alternative applications, I discovered that this same focused microwave technology for missile detection could, in theory, be used to treat cancer cells."

It is well known that heat kills cancer cells, but researchers have had problems using it to treat cancer deep within the body without burning the skin. The focused microwave radiation in the new technique avoids heating the skin. It works by heating, and killing, cells that contain high amounts of water while leaving normal cells unaffected. Breast cancer cells have a water content of approximately 80 percent, as compared to 20 to 60 percent in normal cells. According to MIT, eight out of 10 Phase I patients who had received a single treatment experienced tumor reduction of at least 50 percent, and the only side effect was a slight fever for a few days following treatment. The process has the potential to reduce or eliminate the need for surgery, radiation, and chemotherapy. Details are available at **www.mit.edu**.

Computers and Networking

Pentium® 4 Processor Introduced



Late in November, Intel Corporation **(intel.com)** introduced the Pentium 4, the latest version of its computer microprocessors. It is based on the NetBurst™ micro-architecture, which is a collection of 32-bit processing technologies. Intel says that the new processor features enhanced performance for video and audio processing, Internet applications, and 3-D graphic display. The Pentium 4 is based on the Intel 850 chipset, employing dual RDRAM memory banks and a 400 MHz system bus for data rates up to 3.2 GBytes/second. In quantities of 1,000, the processors are expected to sell for $644.00 (1.4 GHz) and $819.00 (1.5 GHz) each.

Beta Version of New OS Released

Microsoft **(microsoft.com)** has released the Beta 1 release of the next version of Windows®, code named "Whistler." The release was distributed to selected partners and customers as well as 200,000 software developers for test and analysis. Although Whistler is an evolutionary product based largely on existing Windows 2000 technology, it is the first 64-bit version that will be available for early evaluation on Intel Itanium-based systems. The commercial product is to be released in phases, beginning with desktop products and following with server versions. Both should be on the market by the second half of 2001.

MOST Network Endorsed for Automotive Applications

The Automotive Multimedia Interface Collaboration organization **(AMI-C, www.ami-c.org)** appears ready to endorse the Media Oriented Systems Transfer (MOST) network for future automotive applications. AMI-C members include BMW, Ford, Fiat, DaimlerChrysler, General Motors, Honda, Mitsubishi, Toyota, Volkswagen, and other major carmakers, so this is considered to be a very important endorsement. MOST networks are based on a 25 Mbit/second fiber optic bus, which is considerably faster than the 250/kbit/second IDB-C bus currently used in many vehicles. The MOST network can be used for improved performance in navigation systems, CD players, video displays, cell phones, and other digital automotive components. It is not, however, expected to replace copper-wire power-train control buses used under the hood, as they are cheaper and considered to be more durable. The network is expected to be used as early as next year in some luxury vehicles from BMW, with other carmakers following soon afterward.

Dell Computer Reaches Beyond PC Market

Dell PowerEdge servers.
Photo courtesy of Dell Computer Corp.

Seeking to shed its image as a PC company only, Dell Computer **(www.dell.com)** has upgraded its line of servers. The company actually ships 25 percent of all Intel-based servers in the US and has 15 percent of the world market, and Dell intends to challenge Compaq for the number one spot in the industry. Recent introductions include the PowerEdge™ 1550, which is the most powerful unit presently sold by Dell. It includes dual Pentium III processors, clock rates up to 1 GHz, and dual independent 64 bit/66 MHz PCT buses, plus up to 4 Gbytes of RAM and storage of up to 108 Gbytes. The system, which should be available by the time you read this, lists for $2,599.00.

Dell has also teamed up with Unisys Corp. to market a 32-processor PowerEdge server based on the Unisys Cellular MultiProcessing (CMP) server architecture. The design supports Pentium III Xenon III technology and will accommodate the new Itanium processor when it is available. The system, designed for data-intensive computing environments, is scheduled to be available sometime in the first three months of 2001.

Bluetooth Technology Moving Closer

Over the next few months and years, you are likely to hear more about Bluetooth, which is a new short-range networking technology designed to replace cables for connecting intelligent devices such as cell phones, radios, pagers, digital cameras, laptop computers, printers, etc., allowing them to share data. The link operates in the 2.4 GHz band using a frequency-hopping scheme. Although Bluetooth devices will have a maximum communication range of about 10 meters, you can expect a respectable data rate of 1 Mbps or more. Reportedly, the technology will cost manufacturers only about $5.00 to implement, which should add to its appeal. Hewlett-Packard's latest OmniBook laptops, for example, includes space for Bluetooth electronics to be implemented in future models.

The founding members of the Bluetooth special-interest group include Ericsson, IBM, Intel, Nokia, and Toshiba. These have been joined by Compaq, Dell, Lucent Technologies, Morotola, Qualcomm, and others. For the complete story, you can log onto the official Bluetooth web site, **www.bluetooth.com**. The name, in case you were wondering, is a reference to the Danish king Harald Blåtand (Bluetooth) who unified Denmark and Norway.

Circuits and Devices

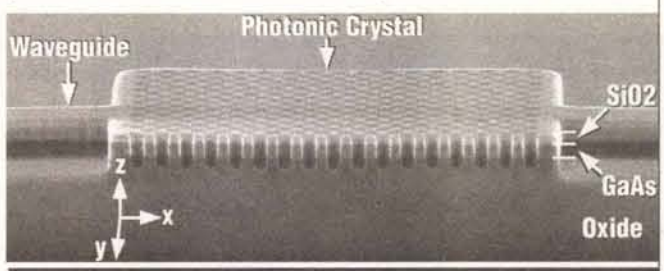
New Device Brings 42 V Auto Systems Closer

One of the problems with planned 42 V automotive electrical systems is their susceptibility to voltage spikes that can occur when, for example, battery cables fail or are disconnected while the car is running. Such spikes can reach levels of hundreds of volts and damage sensitive components. Existing voltage suppression devices such as rectifiers and MOVs generally offer a clamping range that is no better than 10 to 20 V, which is not good enough for automotive electronics. But a new two-terminal MOSFET device developed by the University of Michigan-Dearborn and ON Semiconductor (www.onsemi.com) can hold overvoltages to within 4 V of the specified maximum, i.e., from 52 to 56 V in a 42 V system. This is particularly important for the implementation of future technologies, such as "steer-by-wire," "throttle-by-wire," and "brake-by-wire" applications. These electromechanical systems

will have no hydraulic backups, so reliability is of paramount concern. The new devices will also save money by reducing the amount of high-voltage testing that electronic devices have to undergo before being approved for automotive use.

Circuit Bends Light with Minimal Loss

Sandia National Laboratories **(www.sandia.gov)** has developed a device that can be used to bend infrared beams with very little loss of light. The device, which physically resembles cheesecloth, is actually a two-dimensional artificial crystal that conducts light and is therefore termed a "photonic crystal." In natural crystals, the set molecular spacing permits only certain wavelengths of light to pass through them. But the spacing of holes can be varied in the photonic crystals to conduct a range of desired frequencies. Built of gallium arsenide, these crystals have little measurable loss or distortion as they guide infrared light around sharp corners. It is believed that these devices may ultimately be used as replacements for electronic chips, and the technique could be used to combine light with electrons on a single chip. They may provide performance improvements in lasers, optical communications, and computers.



(Photo courtesy of Sandia National Laboratories)

Improvements in Solar Power Generation

As of 1998, the total world production of solar electric power was only about 100 MW, which does not constitute a major energy source. However, several companies are ready to manufacture and sell a new breed of solar panel that is based on thin films of cadmium telluride (CdTe), and the new technology could bring the price of solar energy closer to that of fossil-fuel processes. As a result, global photaic production capacity is expected to expand to more than 350 MW by 2002. One company, First Solar **(www.firstsolar.com)** has built a manufacturing facility with a capacity of at least 25 MW per year, and the devices are expected to sell for about 60 percent of the price of the more familiar silicon cells. The initial product offering will be the FS-50 cell, which is rated at 50 W and designed for medium to large scale applications (2 kW peak or higher). It is best suited for 48 VDC applications, hybrid systems, and utility installations including covered parking and commercial rooftops. The FS-50 measures approximately 24 x 48 inches. Shipments are expected to begin in the next few months. The price has not been announced, but it is known that the industry is working toward a goal of providing solar power for $2.00 per watt.

Industry and the Profession

RTI Commercializes New Semiconductor Technology

The Research Triangle Institute (RTI) has created a spinoff company to commercialize a technology that could change the way electronics companies integrate semiconductors in their products. The company, Ziptronix, Inc. **(www.ziptronix.com)**, has secured $6.5 million in venture capital. The lead investor is Atlanta-based Alliance Technology Ventures.

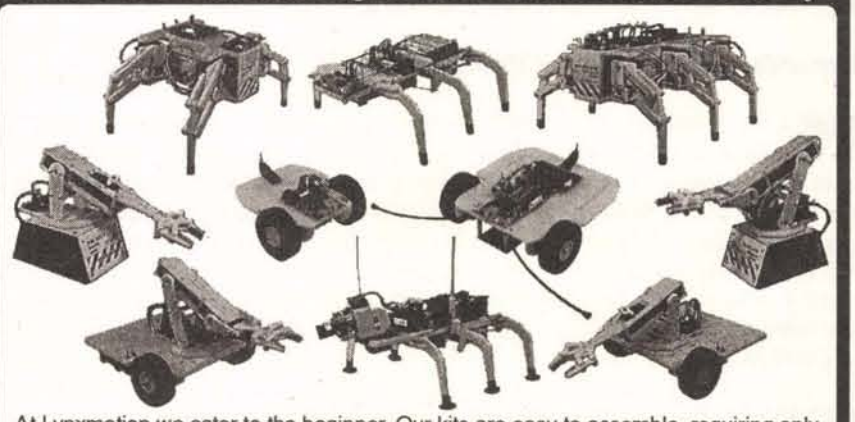
According to RTI, Ziptronix technology allows integration through "wafer bonding and backside processing." The process starts with a host wafer containing many chips. Next, other wafers or individual chips are bonded to the host wafer at room temperature. Ziptronix then removes all the excess substrate from the second wafer or individual chips and, through "backside processing," interconnects them to the host wafer. The interconnect process is identical to that used in standard semiconductor fabrication facilities to electrically interconnect different layers of a single wafer. This process can be repeated, adding more chips to the structure. The end result is an integration of multiple chips (even chips made in different semiconductor materials) into a single chip, without leaving a wafer fabrication facility. This bonding and interconnect process is the foundation of the company's claim of "zero integration penalty." The process is said to offer the possibility of major advancements in wireless communications and other applications.

Motorola Labs Scientist Receives Award for Molecular Electronics Research

The Joint Research Center for Atom Technology (JRCAT), a Japanese government lab, has awarded Nami Choi, Principal Staff Scientist at Motorola Labs, a special award for "Development of Ultimate Probes for Scanning Probe Microscope with Carbon Nanotubes." Choi was recognized for her achievement in affixing a new type of carbon molecule, called "carbon nanotubes," to the end of the probe tip of an atomic force microscope (AFM). The carbon nanotubes are just a few nanometers in diameter. A single carbon nanotube was successfully affixed to extend about one thousandth of an inch from the end of the AFM probe tip, thereby creating an extremely sensitive probe for microscopic imaging. The resolution enhancement is at least 3x better than that achieved with a conventional AFM, and was demonstrated by imaging DNA molecules that are about three nanometers in diameter.

New IEEE President

Dr. Ned Sauthoff became president of The Institute of Electrical and Electronics Engineers — United States of America (IEEE-USA) on Jan. 1, 2001. He served the past year as president-elect of the organization. Dr. Sauthoff is a physicist who heads the Off-site Research Department of the United States Department of Energy's Princeton Plasma Physics Laboratory (PPPL) in Plainsboro, NJ. He began his career there after he earned a Ph.D. in astrophysics from Princeton University in 1975. He has headed numerous departments at PPPL, including the Physics Department, from 1992-94, and the Plasma Science and Technology Department, from 1994-97. As president, Dr. Sauthoff is the highest-ranking volunteer member of IEEE-USA and will chair its board of directors. He will also serve at the international level on the IEEE executive committee and board of directors. He succeeds Merrill Buckley and will work closely with Buckley and 2002 President-Elect LeEarl Bryant of Richardson, Texas. For more background information on Dr. Sauthoff, visit **http://www.ieeeusa.org/volunteers/sauthoff.html**. **NV**



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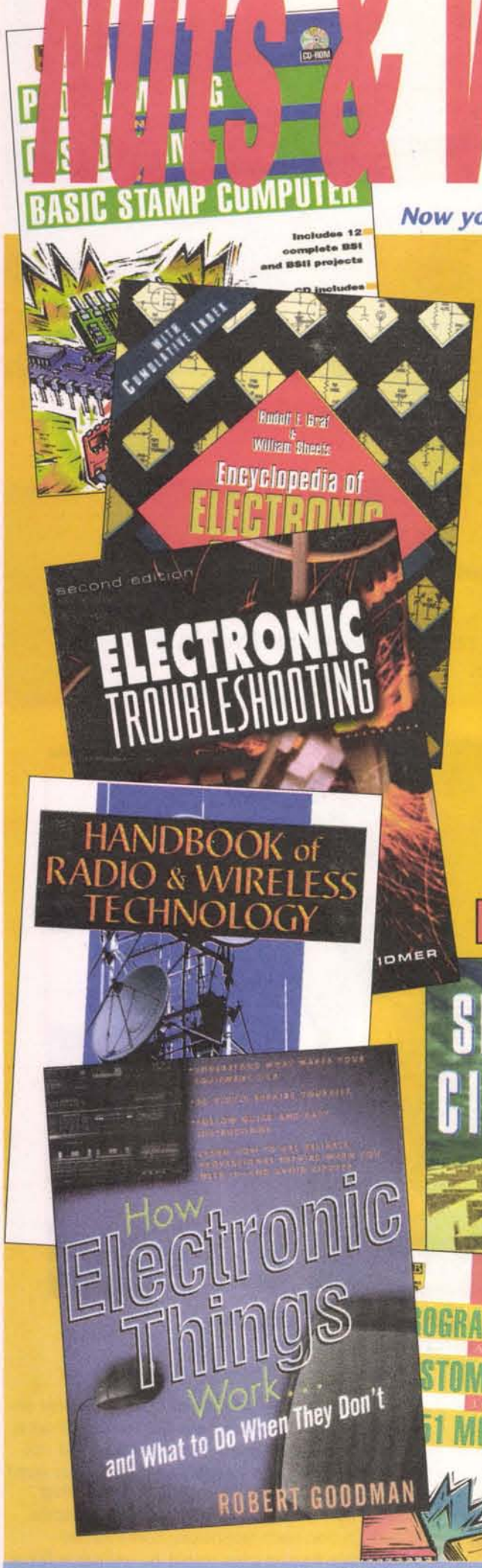

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PRACTICAL RANGE OF AMATEUR TELEVISION IN AIRCRAFT

by Gordon West

Amateur radio television camera will be part of the regular forward looking infrared system on right side.

Amateur radio operators are constantly finding innovative ways to communicate, other than just gabbing over a microphone, or sending packets of information over computer wireless links. Licensed ham operators may bounce signals off the moon, span hundreds of miles with laser lightwave communications, beam microwaves over distances beyond line-of-sight through tropospheric ducting, and maybe send visual images from point-to-point.

Most amateur operators are also members of emergency groups serving their city, county, or state. Some municipalities use ham operators at almost anytime of an emergency event, yet many urban cities who may have the latest in 900 MHz digital equipment have little place for ham radio operation because the hams might not have near the sophisticated equipment that the city is already running for communications.

Drilling a hole for the approved ATV antenna (Comant TSO'd aircraft antenna).

MAYBE — HOW ABOUT TELEVISION?

Ham radio manufacturer Kenwood Corporation makes sending high-resolution, color, still photos over the FM airwaves a snap with their portable VC-H1 visual communicators. OAR Corporation also has their own version of this Tasco-manufactured digital camera that converts video images into a datastream to be sent over conventional 5 kHz FM channels. Many hams presented this type of imaging system to their local municipalities for emergency situations, and they loved the portable capabilities of sending images back over non-city airwaves to an emergency operations center.

But we would caution any ham group with this type of equipment to only use it during brief training periods with a city or county system, and not allow the amateur radio bands to be mis-used by municipalities thinking that any licensed ham on staff could use ham radio on a daily basis to carry out their day-to-day activities. Confine the use of radio and video imaging to brief practice periods with the city, and make your equipment and hams available during any city- or county-wide emergency.

FAST-SCAN TELEVISION

Fast-scan television would be the dream of any city or county municipality in a disaster situation. Actually, they would like to have it on a daily basis, but amateur radio rules would not permit this. We don't want our ham bands used for communications of a regular nature that should take place on regular city frequencies.

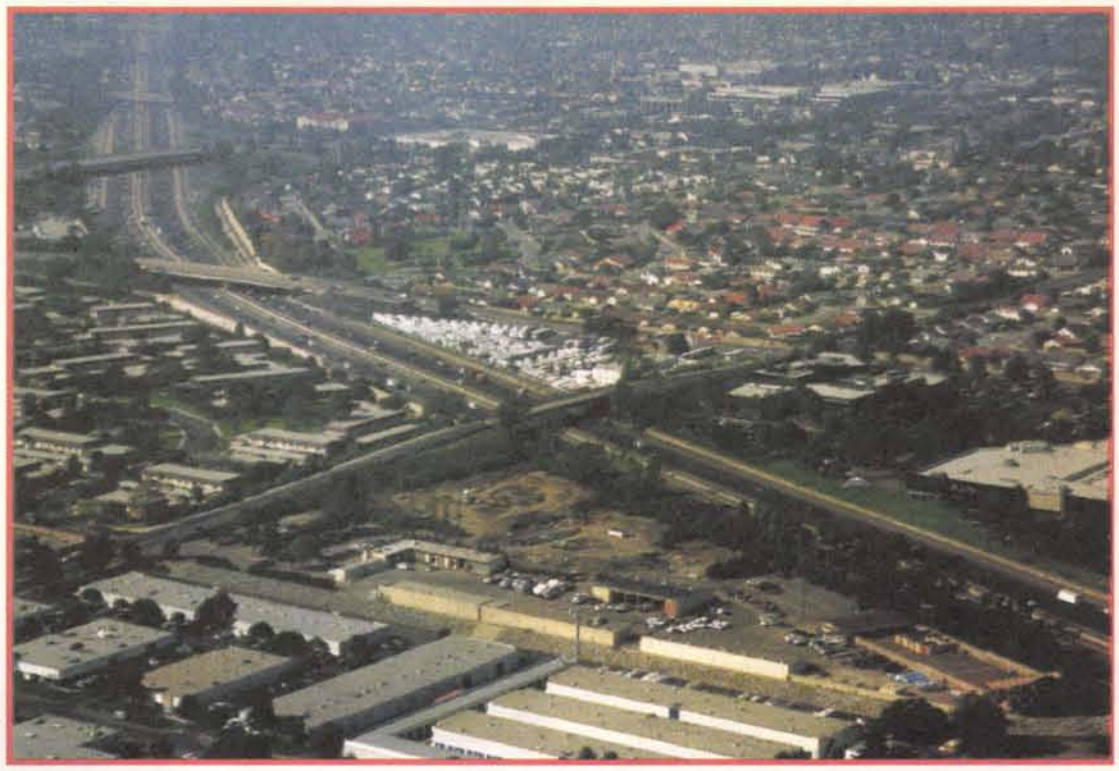
With non-ham television, commercial microwave frequencies might be available for a city to go wireless in showing pursuits from their police helicopter to the watch commander's office, but the equipment for this type of technology seen on your local news channels is

probably thousands and thousands of dollars over budget, and agreements with the local news helicopter are probably in place for a bird's eye view of what's happening with ground units.

In an emergency, as well as one hour a week of training with an authorized Radio Amateur Civil Emergency Service unit (RACES), live color wireless amateur radio television may really pump up the importance of cities and counties working closely with their amateur radio emergency groups.

"While public safety organizations are prohibited from using amateur radio frequencies for their normal operations, there is no reason that they cannot work with local hams for amateur television as part of a weekly or annual drill, or in an emergency," comments Tom O'Hara W6ORG, with PC Electronics in Arcadia, CA (www.hamtv.com).

"Video surveillance of high-crime areas, parades, fires, and other events on a weekly or



A "P-5" snow free TV signal four miles away.

Amateur radio operators offering their city amateur television capabilities must make it clear to the city communications director that these transmissions may only take place during limited-time drills and during unusual or emergency incidents where the protection of property or safety of life is at hand.

intermittent basis are legal uses of amateur television in connection with a city and are encouraged as long as the person controlling the transmission is a licensed radio amateur, and the intent of the rules is not abused," adds O'Hara. "Amateur television can add another remote eye from a rooftop, vehicle, or police helicopter back to a command center in an emergency or drill," states O'Hara, pointing out that the regular daily use of amateur television for a city or county public safety agency is specifically prohibited in the rules.

Amateur radio operators offering their city amateur television capabilities must make it clear to the city communications director that these transmissions may only take place during limited-time drills and during unusual or emergency incidents where the protection of proper-

Tracking the helicopter television signal from Gordo's "overland" command post.

ty or safety of life is at hand.

AMATEUR TELEVISION FREQUENCIES

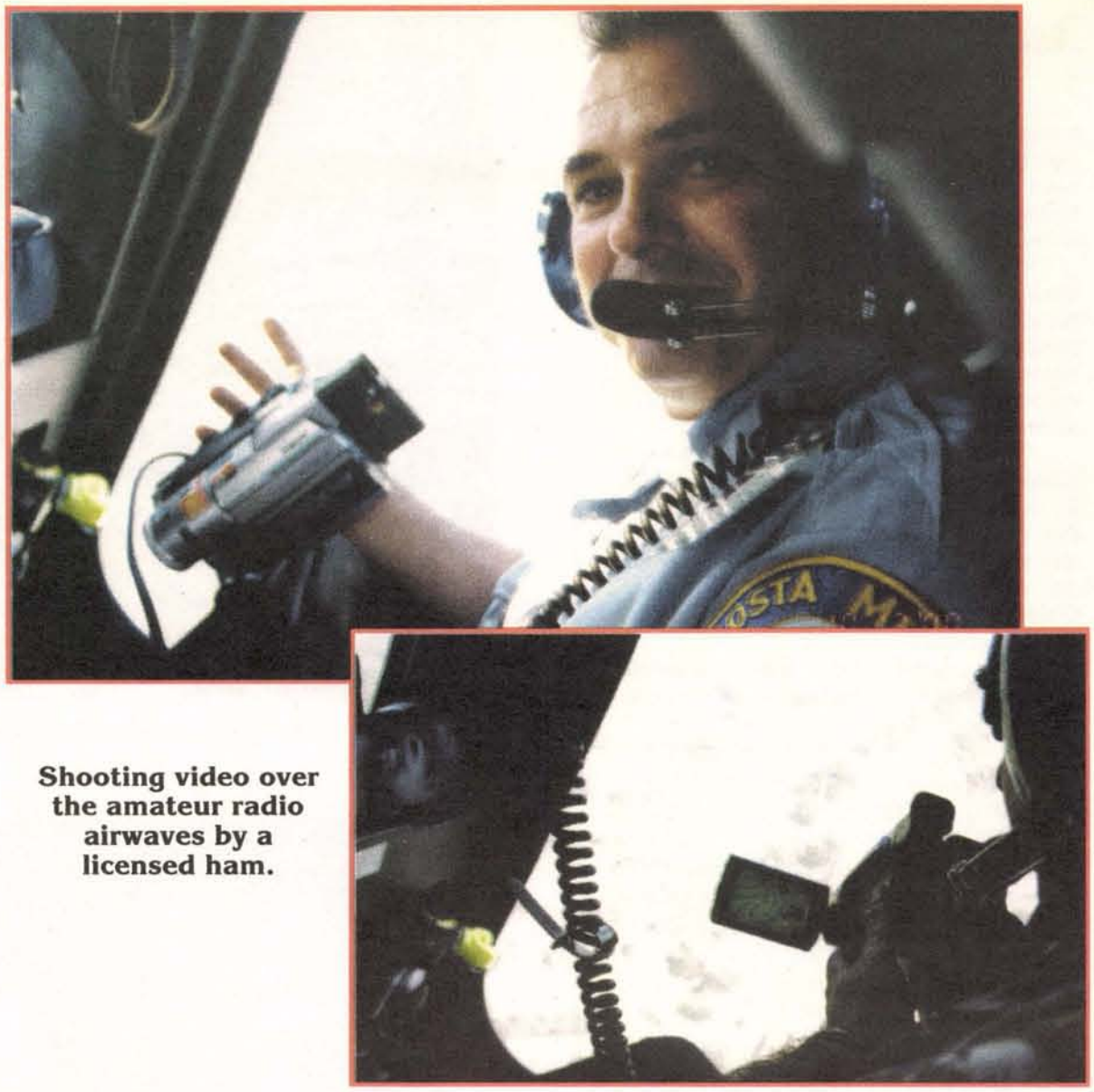
Wireless television video with included audio is an extremely wide mode, taking up as much as 6 MHz (not kHz!) of bandwidth. Amateur television frequencies are coordinated by geographic local area band plan coordinators. Most amateur television activity is on several "channels" on the 420 MHz 70 cm band, plus 900 MHz, 1200 MHz, 2400 MHz, and 10,000 MHz.

Most radio amateur first-time television groups start out transmitting and receiving simplex imagery on the 70 cm band. The 420 MHz band offers the least path loss, and 70 cm Yagi antennas are plentiful. Many areas may also offer amateur television repeater capabilities, too — the repeater will listen to a specific channel on 70 cm, and retransmit any signal coming in on either 900 MHz, 1.2 GHz, or higher. Usually a two-meter frequency is used for voice coordination to insure no one else locally is trying to use amateur television on the same channel.

Most amateur television signals use the same exact format as what you might pick up from your local television broadcasting station. The video signal is analog amplitude modulation, and the accompanying mic audio is frequency modulation. This allows you to use conventional VCR, camcorders, and separate audio/separate video components with this common NTSC format. Some amateur operators may identify their signals constantly with their call sign at the bottom of the screen, yet others may announce their ID by saying their call letters within the video signal. Yet other beginning new hams may simply hold up a card with their call letters on it.

Your trusty video camera or digital camera that output a live video image simply plugs into the modern 10-watt or 20-watt 70 cm transmitter black box. The most popular transmitters come from Tom O'Hara at PC Electronics — Tom is an active ham operator on amateur television, and regularly takes the system up in his own private helicopter.

We have found that some video cameras are extremely sensitive to a nearby antenna transmitted signal scrambling the picture. This means that you must keep the video camera as far away from the transmitting ATV antenna as possible. You may even need to put your video camera in an aluminum sack with only the lens protruding, and use RF chokes along the connections between the camera output and the black box 10-watt or 20-watt transmitter. Anytime you see a signal that appears to have lost horizontal hold, it very well could be RF from a nearby antenna feeding back into the camera.



Shooting video over the amateur radio airwaves by a licensed ham.

The city of Costa Mesa supports the amateur radio operators with the helicopter amateur radio television equipment.

Unless you are going with a massive studio-quality camera with thousands of dollars worth of shielding on the inside, you won't be able to run much more than 20 watts output to any antenna within 30 feet of the camera. This means that the 100-watt linear amplifier won't work with most aeronautical installations. About the only time you can get away with running a linear amplifier and a simple camcorder as a camera is when your directional antenna is way up on a tower, and the very best hard-line coax cable is employed.

Receiving the transmitted signal requires a very inexpensive downconverter. In fact, if you have a television set with cable channel reception, you may find you can pick up 70 cm 420 MHz and 434 MHz local ham transmissions on cable TV channels 57 through 59 — not UHF, but cable channels 57 through 59 with an outside UHF antenna in place of your normal cable TV feed.

But I would recommend a separate GaAsFET downconverter, commercially made by PC Electronics, offering more gain and better out-of-band filtering in its downconverter process. The downconverter also has a fine-tuning knob for spot-on picture capture with adequate audio recovery.

IN ACTUAL USE

The city of Costa Mesa radio amateur emergency team (MESAC) has run exhaustive

amateur television operations with fellow members, as well as through the prestigious Orange County RACES organization. Jim Carter WB6HAG, and Ray Grimes W6RYS, lead the Orange County RACES amateur television efforts, and conduct regular fast-scan and slow-scan weekly nets to help all of their host cities improve their amateur television transmission capabilities, especially in an emergency when the equipment must be set up in less than five minutes.

"Most important, make sure you have a clear view to the receiving station," comments Jim Carter in his *Introduction to ATV and Procedure* manual. And this be the truth — read on.

You will quickly be disappointed that the 20-watt, 6 MHz wide, 70 cm, 434 MHz ATV signal won't go more than a mile or two "on the deck" — that is, Yagi antenna to another Yagi antenna with trees and buildings in between. Many times we saw the picture deteriorate when a mobile station running considerable power went beyond a five-block radius from our second-story, omnidirectional antenna. Multi-path reflections, ghosts, and dropouts also occur when you begin to exceed a paltry one-mile distance.

Now, for a line-of-sight ATV shot from Yagi to Yagi, the signal has been received over 2,500 miles from Hawaii to my station in California.

Amateur television at 20 watts will go mountaintop to mountaintop over 100 miles easily. At the Pasadena Rose Parade, a well-elevated ATV receive station was picking up simplex 70 cm ATV signals and 900 MHz ATV signals for miles around when the floats were "in the clear."

So what happens when you put a 20-watt PC Electronics ATV transmitter in a police helicopter? The city of Costa Mesa wanted to find out, so MESAC ham radio operators prepared for the simplex 70 cm test. Our ATV coordinating frequency would be 144.390 MHz, and we would be operating ATV simplex on 426.250 MHz, the common frequency found in a two-channel PC Electronics ATV transmitter. The helicopter test involved a five-minute deployment of the equipment in the helicopter as a test of our emergency preparedness. The ATV transmitter would operate off of its own 17-amp-hour battery pack, and the camcorder was a simple CCD low-cost special with separate video and audio output jacks that would plug into the separate video and audio input jacks on the 20-watt 70 cm transmitter.

The antenna was a halfwave, shunt-fed land mobile antenna to give us a good signal right off the tip end as it was pointed straight down. The antenna was permanently affixed to a mounting plate on the helicopter, and in the future, we will be developing a sleeve to allow the antenna to slide over the common foot-step found on most helicopters of the approximate same diameter.

We had several reception points, but our two-story emergency operation center had absolutely no reception of the signal when the helicopter was on the ground just five miles away! Yet we could see a good signal in our communications van command post just a few hundred yards away, even without any antenna attached to the down-converter. But still no signal at the EOC (Emergency Operation Center) radio and video room operated by the city of Costa Mesa radio amateur volunteers.

But once the helicopter lifted off the pad with three licensed amateur operators aboard (two MESAC members plus the licensed ham pilot), the received picture popped in like someone had thrown a magic switch. From that point on, picture quality was "P3" which is good but with a little snow, and many times "P4" and "P5" as the helicopter gained altitude and was in continuous line-of-sight with the EOC vertical antenna. A police call to Newport Beach takes the helicopter many miles away from the receiving station, but reception is still good until the helicopter drops altitude and is no longer line-of-sight to our second-story antenna. And just like a switch being thrown, the signal almost instantly drops out. But as soon as the helicopter comes back into view at 300 feet altitude, the signal again reappears.

The Costa Mesa Police helicopter flies throughout the city with incredible amateur television pictures. The communications van has good capture of the signal as the helicopter is in view, and extraordinary "P5" signal when the helicopter takes a momentary 1,500 foot climb as part of our test. Indeed, line-of-sight is the answer with absolutely zero reception when anything gets in the way!

More good news — soon the helicopter will be outfitted with a new video surveillance system, and this will output to a separate audio and video jack that hams can jump in and tie into. There are no plans to boost the power output of the video transmitter because the helicopter must monitor several other 460 MHz frequencies and cannot take any desensitization from the 426 MHz 20-watt video signal.

Our biggest lesson learned was the reflection, blocking, and absorption of ATV signals when attempting ground-to-ground, point-to-point transmitting, even with powerful Yagi antennas. We briefly tried 100 watts sending a non-video bus electronically generated call sign image, and range through the houses and the trees barely increased by a half mile. If you have the path, 20 watts will do just fine — and if you don't have the path, even 100 watts on ATV won't necessarily get through much better.

But for the helicopter ride, it was ATV at its best.

Once again, the city was informed that ATV may not be used by the public safety agency for day-to-day routine events, even though the pilot and other operators may indeed hold an amateur radio license. However, in an emergency or during short drills, flying with amateur television really opened some public safety eyes as to the capabilities of what amateur radio communications may do for emergency and emergency preparedness. **NV**

Light That Switch

by Bob Vun Kannon

My laboratory has the switch for the lighting located well away from the entry door. So, to turn on the lights, I had to walk across a dark lab and fumble around for the light switch.

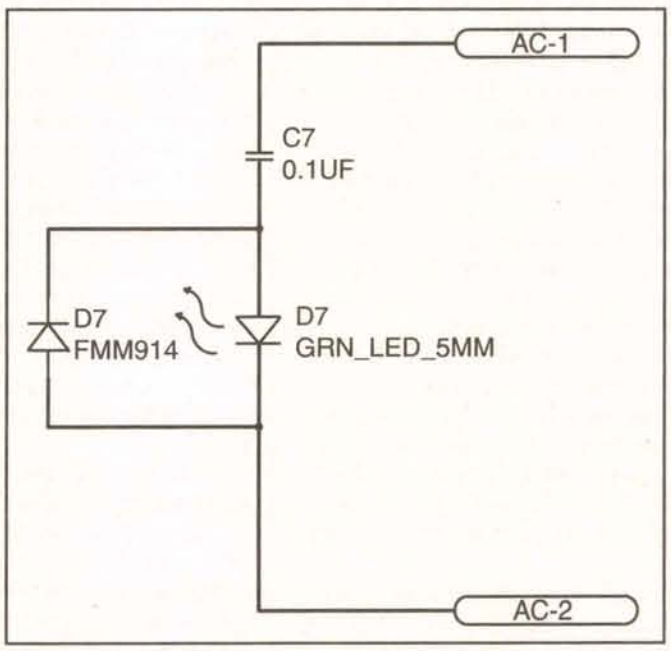
But the fumbling around is a thing of the past now. I put a light on the switch that is on whenever the lighting is off and draws pretty close to no power. It also dissipates extremely little heat. Here's how to do it.

The Lamp

An LED (light emitting diode) is an obvious choice for this job. When turned on with five milliamps of current, it will use only about 0.01 watts.

Current Control

The trick in this circuit is to not burn power in the current controller. If a resistor were chosen to limit the current, it would need to dissipate about .57 watts (.005 amps * 115 volts). There's a much better way. Use a capacitor instead of a resistor. The current flow in the capacitor is orthogonal (90 degrees out of phase) to the voltage across it, so half of the time it absorbs energy and half of the time it delivers the energy back. The net result is essentially no power dissipation in the capacitor. The current delivered will be approximately 115/6.28/60/C, where C is in farads. I've chosen a 0.1 uF cap to supply about five milliamps to the LED. If that's not bright enough for you, try putting a second .1 uF cap in parallel with the first capacitor to double the current.



Protect the LED

The second diode, labeled an FMM914, can be just any old logic diode. Its function is to prevent a large reverse voltage from appearing across the LED and to provide a discharge path for the capacitor. A 1N914 or 1N916 or 1N4148 (or almost any other diode) would work well here.

Wiring the Circuit

Connect the two terminals labeled "AC-1" and "AC-2" to the posts of the switch for the lighting. If there is any incandescent light on the circuit, this will work.

What happens when you turn the lighting off is that the incandescent light in the circuit provides a low impedance return path to the AC line, allowing the small five milliamp current for the LED to flow with essentially no voltage drop.

I recommend drilling a hole in the cover plate of the lighting switch and mounting the LED there. The other two components can easily be mounted on the back side of the plate.

Then run the two connections to the power switch (after turning the power to the switch off!) with hook-up wire, leaving an adequate service loop. **NV**

Continued from page 42

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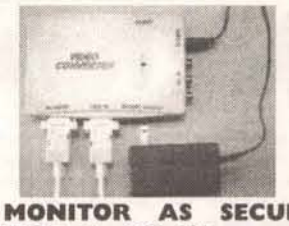

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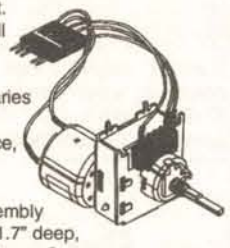

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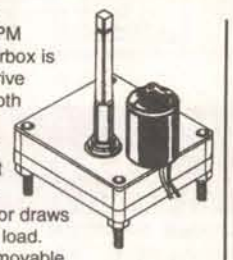

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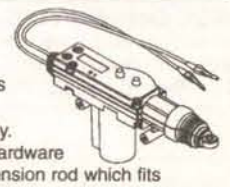

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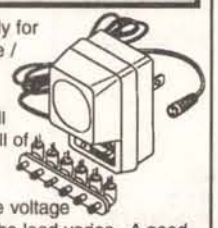

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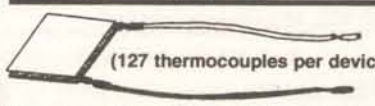

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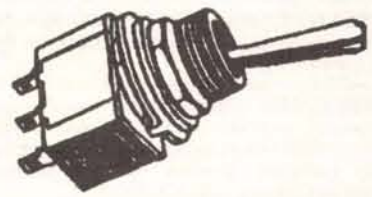

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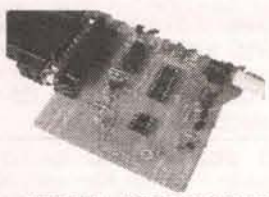

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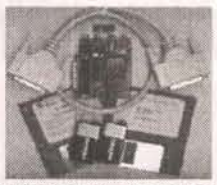

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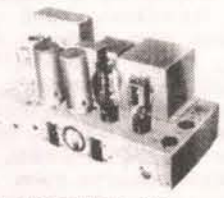

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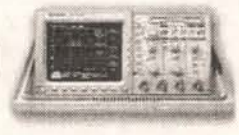

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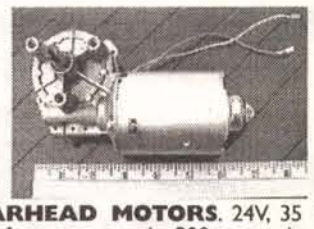

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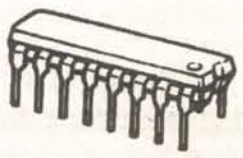

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CMOS DING-DONG CHIME

by Dennis Eichenberg

The circuit shown is an inexpensive chime circuit, which produces a pleasant "ding-dong" tone. CMOS integrated circuits were used to minimize power requirements, and permit circuit operation from five to 15 volts.

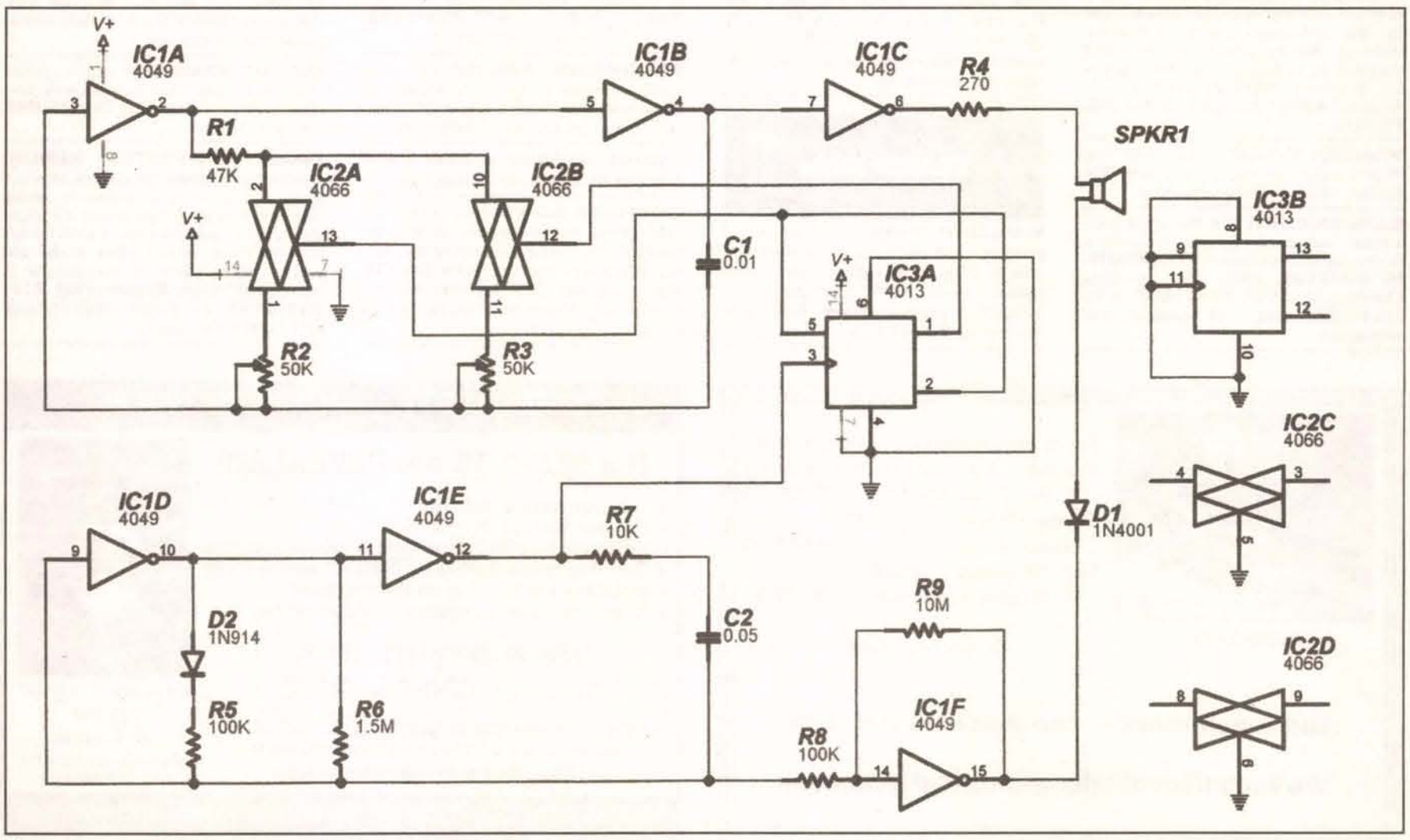
The heart of the circuit is the 4049 hex inverter, IC1. IC1A and IC1B are configured as an astable multivibrator which produces the audio tone based upon the relationship that $f = 1/[2.2(R1+R2)(C1)]$ in the "ding" state, and $f = 1[2.2(R1+R3)(C1)]$ in the "dong" state. IC1C acts as a buffer to drive an eight-ohm speaker. Speaker volume is easily adjusted by varying the value of current limiting resistor R4. The minimum allowable value of R4 is 220 ohms.

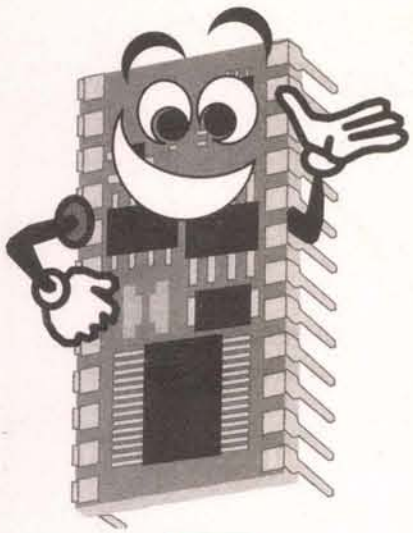
IC1D and IC1E are configured as an astable multivibrator which produces the chime rate based upon the relationship that $t_{hi} = 1.1(R6)(C2)$ and $t_{lo} = 1.1(C2)(R5||R6)$. R7 is included to produce decay for the chime tone. IC1F is configured as an inverting amplifier for the rate multivibrator.

IC3 is a 4013 D flip-flop configured as a T flip-flop to provide a symmetrical square-wave control signal to IC2 from the rate multivibrator. IC2 is a 4066 quad bilateral switch to select R2 or R3 for the tone multivibrator. **NV**

CMOS DING-DONG CHIME PARTS LIST

No.	Description
IC1	Hex Inverter, CMOS, 4049
IC2	Quad Bilateral Switch, CMOS, 4066
IC3	Dual D flip-flop, CMOS, 4013
D1	Diode, 1N4001
D2	Diode, 1N914
R1	Resistor, 47K, 1/4 watt
R2, R3	Potentiometer, 50K 1/4 watt
R4	Resistor, 270 ohms, 1/4 watt
R5, R8	Resistor, 100K, 1/4 watt
R6	Resistor, 1.5M, 1/4 watt
R7	Resistor, 10K, 1/4 watt
R9	Resistor, 10M, 1/4 watt
C1	Capacitor, 0.01µF, 25 WVDC
C2	Capacitor, 0.05µF, 25 WVDC
SPKR	Speaker, eight ohms





by Jon Williams

Stamp Applications

Let There Be Leds

Putting the Spotlight on BASIC Stamp Projects, Hints, and Tips

I really enjoy Dallas. The city is clean, the people are friendly and aside from some occasionally wacky weather (it snowed last weekend; today it's in the 60s, and I'm as sick as a dog as I write this ...), it's just a great city to live in. And at the risk of repeating myself, one of the best things about Dallas – in my opinion – is Tanner Electronics. Tanner's – a family-owned and operated surplus store – is to the electronics enthusiast what Willie Wonka's factory is to a chocolate addict. Jim Tanner and his family always have a smile and time for a customer.

While roaming the aisles on a recent parts run to Tanner's, I came across a two-inch tall, 5x7 common-cathode LED matrix (the kind used in big LED signs). I didn't have any particular use for it at the time, but it looked interesting and for $2.00, I thought it would be worth playing with. I was right.

I like this particular matrix because it's a set of raw LEDs and, other than its row/column wiring, there is no internal logic. What this means is that with a little bit of programming, I can display whatever I want: characters, graphics, anything. If you're only interested in displaying numbers and letters, there are arrays available with built-in ASCII decoders.

While roaming the aisles on a recent parts run to Tanner's, I came across a two-inch tall, 5x7 common-cathode LED matrix (the kind used in big LED signs). I didn't have any particular use for it at the time, but it looked interesting and for $2.00, I thought it would be worth playing with. *I was right.*

To control 35 LEDs individually would take a lot of I/O, not to mention power-supply current. And my LED is pre-wired as a 5x7 array, so it expects to be multiplexed. For review, multiplexing is the process of illuminating a portion of a display (a single digit or column, for example) for a short time, then another portion, then another, and so on until we get back to the first element. This process takes place rapidly so our eye doesn't perceive any display flicker. The biggest advantage to multiplexing is that it cuts down the number of I/O lines required to drive a given display. In our project, we will be able to control 35 LEDs with just 12 lines.

Multiplexing can be accomplished with the Stamp, and yet, the process consumes a lot of horsepower and leaves us little time to do anything else. So what do we do? We pick up Maxim's MAX7219 LED display driver, that's what we do.

Scott Edwards introduced the MAX7219 to Stamp users way back in December of 1995. In that project, Scott used the MAX7219 in its traditional role: to control several seven-segment (numeric) LED displays. This is easy to do with the MAX7219 because it contains decimal (and hex) decoding logic to properly display digits on seven-segment LEDs. What we'll do this month is disable the decimal (BCD) decoding and take full manual control of the chip. By doing this, we have complete control of up to 64 individual LEDs – all with just 16 lines from the MAX7219. From the Stamp's point-of-view, we only need three lines for the display since the Stamp communicates with the MAX7219 with **SHIFTOUT** over a standard three-wire interface.

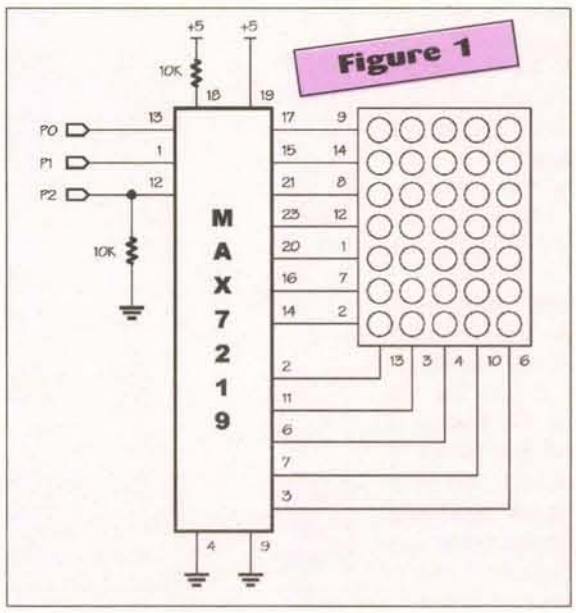
Okay, you've got the idea, so let's just jump right into it. There's only one program this month and it's packed. Of course, you're free to selectively remove portions of the main code block that you don't care about. If you don't have a standard PC joystick, you'll need to modify the code so that it doesn't get stuck in the "Crosshair" section. Ready? Let's go.

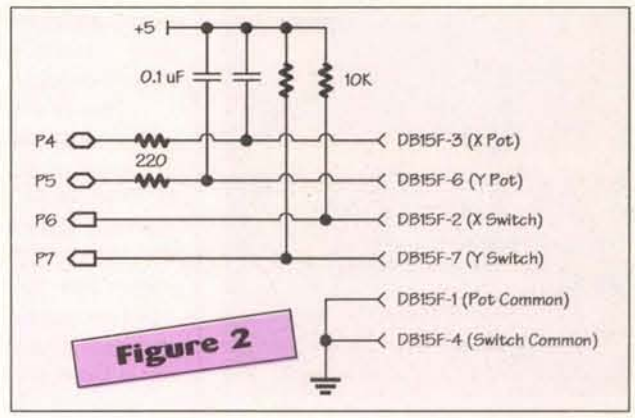
Project Hardware

Yeah, there are a few connections, but the hardware this month is actually pretty simple (see Figure 1). The trickiest part is keeping track of each wire and where it's going. Since this is an experiment, I assembled mine on the new Parallax INEX-1000 board. It's a nice product in that it has a full-sized solderless breadboard, a beefy five-volt supply, and lots of little extras. To be honest, I did have to do some soldering to make an adaptor for the LED array, but that was a pretty simple process and only took 15 minutes or so.

The Stamp sends data to the MAX7219 through a standard three-wire, synchronous serial interface. After sending 16 bits (register and data) to the MAX7219, it's latched into the device by blipping (low-high-low) the load line. You may be wondering why the load line is pulled down to ground through a 10K resistor. Simply put, this resistor holds the load line low while the Stamp is resetting, preventing spurious (bad) data from getting into the MAX7219.

Another surplus part that I had on my bench and wanted to play with was a standard PC joystick. Electrically, a joystick is a pretty simple arrangement of two potentiometers and two normally-open switches. The pots have a common line, as do the switches. This presents no problem for the Stamp. We can use **RCTIME** to measure the pots and, with pull-ups, we can easily monitor the state of the buttons. Figure 2 is the schematic for a joystick interface to the Stamp.





Let There Be LEDs

The Code, The Code

Okay, the hardware is all wired-up, so let's write some code. There's a lot of neat stuff in the EEPROM Data section, but skip over that for the moment and look at the initialization code. The MAX7219 is a register-oriented device. To put new data in a register, we'll use **SHIFTOUT** to send the register number, then the data. After 16 bits have been shifted, the new data is latched into the MAX7219 by using **PULSOUT** to blip the Load line.

When it's first powered-up, the MAX7219 display is cleared, the column scan limit is set to one, the brightness to minimum, and BCD decoding off. For our program, we need to set the scan limit to five (number of columns in the LED matrix), we'll turn up the brightness just a bit, and we'll make sure the display is turned on.

There's a bit of an inconsistency in the MAX7219. To set the scan limit to five columns, we'll put a four in the scan limit register ($0B). After that though, columns are addressed as one through five. We'll need to remember that when writing our code.

We send the initialization data to the MAX7219 by using a **LOOKUP** table that's embedded in a loop. On every other pass through the loop, we'll blip the Load line to latch the register address and data. We can tell when it's time to blip the Load line by looking at Bit0 of the loop counter. When this bit is set, we've shifted 16 bits and it's time for Load.

Now that the display is initialized, we can start sending data. To display a character or graphic, we have to send data (one byte) to each of the five columns. Now go back and look at the EEPROM Data section of the listing. In this section, you'll see that I've defined character maps for space, "B," "S," and "2." Notice that the definitions seem to have been turned on their sides. It's easier to read the map if you rotate the magazine or your computer monitor 90 degrees counter-clockwise. Okay, I'm kidding ... don't tilt your monitor; just follow along.

These definitions may seem odd, especially if you've ever designed custom characters for an LCD module. The reason for the peculiar definition is the nature of the MAX7219's column scan. It works like this: Column one (leftmost) is enabled (made low) and the row data is output on the segment lines. It's held briefly. Column

Listing 1

```
' Listing 1
' Nuts & Volts - February 2000

' -----[ Title ]-----------------------------------------------------------
'
' File..... LEDARRAY.BS2
' Purpose... Uses the MAX7219 to drive a 5x7 LED array
' Author.... Jon Williams
' E-mail.... jonwms@aol.com
' Started... 06 JAN 2001
' Updated... 07 JAN 2001

' {$STAMP BS2}


' -----[ Program Description ]---------------------------------------------
'
' Demonstrates the use of Maxim's MAX7219 LED display driver in the
' non-decoded mode.  In this mode, the programmer is responsible for
' sending segment (row) data for each digit (column).
'
' In this application, the MAX7219 is connected to a common-cathode LED
' array.  The array is five columns wide by 7 rows tall (35 LEDs).  The
' digit outputs from the MAX7219 are connect to the columns; the segment
' control lines to the rows.
'
' MAX7219 --> LED Connections:
'
'   MAX7219.2  (0) --> Col 1 (left)
'   MAX7219.11 (1) --> Col 2
'   MAX7219.6  (2) --> Col 3
'   MAX7219.7  (3) --> Col 4
'   MAX7219.3  (4) --> Col 5
'
'   MAX7219.17 (g) --> Row 1 (top)
'   MAX7219.15 (f) --> Row 2
'   MAX7219.21 (e) --> Row 3
'   MAX7219.23 (d) --> Row 4
'   MAX7219.20 (c) --> Row 5
'   MAX7219.16 (b) --> Row 6
'   MAX7219.14 (a) --> Row 7


' -----[ Revision History ]------------------------------------------------
'
' 07 JAN 2001 - Version 1


' -----[ I/O Definitions ]--------------------------------------------------
'
Clock           CON     0               ' shift clock to MAX7219
DPin            CON     1               ' shift data to MAX7219
Load            CON     2               '

JoyX            CON     4               ' x-axis pot reading
JoyY            CON     5               ' y-axis pot reading
BtnX            VAR     In6             ' x-axis button
BtnY            VAR     In7             ' y-axis button
JoyBtns         VAR     InB


' -----[ Constants ]-------------------------------------------------------
'
Decode          CON     $09             ' bcd decode
Intensity       CON     $0A             ' brightness
Scan            CON     $0B             ' scan (column) limit
ShutDn          CON     $0C             ' shutdown (1 = on)
Test            CON     $0F             ' display test mode

Yes             CON     1
No              CON     0

GraphMax CON    255                     ' scale value for graph mode
GraphY          CON     GraphMax / 7    ' division value

JoyXMax         CON     6200            ' pre-measure max value
JoyYMax         CON     5730            ' pre-measured max value


' -----[ Variables ]-------------------------------------------------------
'
index           VAR     Nib             ' loop counter
idxOdd          VAR     index.Bit0      ' is index odd? (1 = yes)
```

Let There Be LEDs

```
d7219           VAR     Byte            ' data for MAX7219
char            VAR     Byte            ' character ee address
col             VAR     Nib             ' column value
row             VAR     Nib             ' row value
eeAddr1         VAR     Byte            ' ee pointer
eeAddr2         VAR     Byte
vScroll         VAR     Word            ' scrolling data buffer
grVal           VAR     Byte            ' graph value

joyXval         VAR     Word            ' joystick x reading
joyYval         VAR     Word            ' joystick y reading
xAxis           VAR     Nib             ' target axis
yAxis           VAR     Nib
btns            VAR     Nib             ' button status


' -----[ EEPROM Data ]----------------------------------------------------
'
Char_Space      DATA    %0000000
                DATA    %0000000
                DATA    %0000000
                DATA    %0000000
                DATA    %0000000
                DATA    0               ' column between characters

Char_B          DATA    %1111111        ' xxxxxxx
                DATA    %1001001        ' x..x..x
                DATA    %1001001        ' x..x..x
                DATA    %1001001        ' x..x..x
                DATA    %0110110        ' .xx.xx.
                DATA    0

Char_S          DATA    %0100110        ' .x..xx.
                DATA    %1001001        ' x..x..x
                DATA    %1001001        ' x..x..x
                DATA    %1001001        ' x..x..x
                DATA    %0110010        ' .xx..x.
                DATA    0

Char_2          DATA    %1000010        ' x....x.
                DATA    %1100001        ' xx....x
                DATA    %1010001        ' x.x...x
                DATA    %1001001        ' x..x..x
                DATA    %1000110        ' x...xx.

Pad             DATA    0,0,0,0,0
                DATA    0

GrData          DATA    130,220,255,150,75      ' graph values

Smile           DATA    %0001000        ' ...x...
                DATA    %0010011        ' ..x..xx
                DATA    %0110000        ' .xx....
                DATA    %0110011        ' .xx..xx
                DATA    %0001000        ' ...x...


' -----[ Initialization ]------------------------------------------------
'
Initialize:
  DirL = %111                           ' clock, data and load pins

  FOR index = 0 TO 5
    LOOKUP index,[Scan,4,Intensity,7,ShutDn,1],d7219
    SHIFTOUT Dpin,Clock,MSBFirst,[d7219]
    IF idxOdd = No THEN NoLoad
    PULSOUT Load,3                      ' load parameter
  NoLoad:
  NEXT


' -----[ Main Code ]------------------------------------------------------
'
Main:

Flash_Characters:                       ' on screen, one at a time
  FOR char = 0 TO 3
    LOOKUP char,[Char_B,Char_S,Char_2,Char_Space],eeAddr1
    GOSUB ShowChar
    PAUSE 1000
  NEXT

Crawl_Characters:                       ' crawl on (horizontally)
```

one is turned off and the process is repeated for column two. And so on to the scan limit. When the scan limit is reached, the process starts again at the first column.

Our job then, is to define the sequential column data for each character. Figure 3 shows the letter "B" LEDs lit in the array. A lit LED is equal to a one in the data byte. We just need to keep in mind that the top row of the array corresponds to Bit0 of the data byte.

Moving on, the first part of the demo is called **Flash_Characters**. It does just that: flashes the characters "B," "S," and "2." It works by reading the definition address from a **LOOKUP** table. Once the character definition address is known, **ShowChar** displays the character. This subroutine takes the character address, reads the definition data from EEPROM (five bytes for each character), and sends it to the MAX7219.

A neat side-effect of having our definitions stored sequentially is that we can loop through the addresses and call **ShowChar** to create a crawling (horizontal) window. The MAX7219 is simply presenting the data we send it. If our address is offset from the beginning of a character definition, the character will be offset in the display. With our definitions adjacent to each other in memory, the display will behave accordingly. This is the reason for the zero between each set of character definition bytes. It creates a blank column when the display is crawling.

That explains the behavior of **Crawl_Characters**. It simply loops through the definition bytes and passes the address to **ShowChar** for display. You can change the crawl direction by reversing the direction of the loop. If you do this, though, the "2" will appear first. Finally, the crawl speed is controlled by **PAUSE 250**. You can speed it up by making the **PAUSE** value smaller.

Scrolling characters into the display vertically is a little bit trickier, but thanks to the Stamp's data types and ability to overlay variables, it can be done with just a bit of code. It helps here to visualize two characters stacked on top of each other, and then extend the bits in our definition graphic to Bit15 (the size of a word). By loading character data in the low and high bytes of vScroll, we can scroll characters into the display, bottom to top, by using the right shift (>>) operator.

Take a look at the code in **Scroll_Characters**. A loop is used to scroll through four characters (B, S, 2, and space). **LOOKUP** tables are used to define the starting

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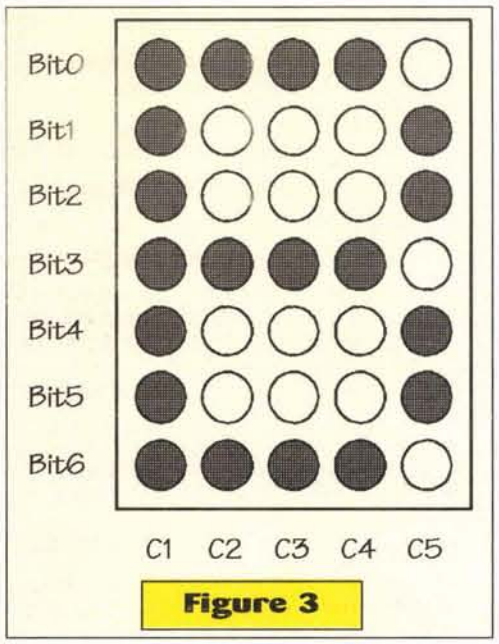

Figure 3

addresses of the scrolling characters (notice the offset in the tables). An inner loop controls the scrolling by shifting our buffer, vScroll, to the right eight times. For each iteration through the scroll loop, we grab the column data for each of the two characters from EEPROM, shift it to the proper "window," and send it to the MAX7219.

The next part of the demo, **Show_Graph**, draws a simple bar graph on the LED matrix using values stored in a **DATA** table. The code for drawing a bar is similar to the scrolling characters code. In this case, we'll scroll a bunch of ones (lit LEDs) into a blank column. The number of ones scrolled in is based on the value for the column. Here's the code:

```
vScroll = $FF80 >> (grVal / GraphY)
```

The value, $FF80, stuffs a bunch of ones into the upper end of vScroll. The shift operator moves the bits. The larger the data value (in grVal), the greater the number of shifts, resulting in a "taller" bar in the graph. The value, GraphY, is a pre-defined constant that determines the value of each lit LED. You can change the value of GraphMax (GraphY is GraphMax divided by seven) in the constants section to accommodate larger or smaller data values. And, if you put the graph values in an array, you could create a scrolling


```
  FOR eeAddr1 = Char_Space TO Pad
    GOSUB ShowChar
    PAUSE 250
  NEXT
  PAUSE 1000


Scroll_Characters:                          ' scroll on (vertically)
  FOR char = 0 TO 3
    LOOKUP char,[Char_Space,Char_B,Char_S,Char_2],eeAddr1
    LOOKUP char,[Char_B,Char_S,Char_2,Char_Space],eeAddr2
    FOR row = 1 TO 8
      FOR col = 1 TO 5
        READ (eeAddr1 + col - 1),vScroll.LowByte
        READ (eeAddr2 + col - 1),vScroll.HighByte
        d7219 = vScroll >> (row - 1)     ' get "frame"
        SHIFTOUT Dpin,Clock,MSBFirst,[col,d7219]
        PULSOUT Load,3
      NEXT
      PAUSE 200
    NEXT

  NEXT
  PAUSE 1000


Show_Graph:
  FOR col = 1 TO 5                                  ' five colums wide
    READ (GrData + col - 1),grVal                   ' get stored data
    vScroll = $FF80 >> (grVal / GraphY)             ' draw bar
    SHIFTOUT Dpin,Clock,MSBFirst,[col,vScroll.LowByte]
    PULSOUT Load,3
  NEXT
  PAUSE 1000


Crosshair:
  btns = ~JoyBtns >> 2 & %0011                      ' read buttons (1=down)
  BRANCH btns,[ShowTarget,ShowSmile,Main,Main]

ShowTarget:
  GOSUB ReadJoyStick

  xAxis = joyXval/(JoyXMax / 5) MAX 4               ' crosshair column
  yAxis = joyYval/(JoyYMax / 7) MAX 6               ' crosshair row

  FOR col = 1 TO 5
    LOOKUP yAxis,[$01,$02,$04,$08,$10,$20,$40],d7219
    IF ((col-1) <> xAxis) THEN DrawColumn           ' draw crosshair
    d7219 = $7F
  DrawColumn:
    SHIFTOUT Dpin,Clock,MSBFirst,[col,d7219]
    PULSOUT Load,3
  NEXT

  GOTO CrossHair

ShowSmile:
  eeAddr1 = Smile                                   ' point to definition
  GOSUB ShowChar                                    ' show it
  PAUSE 1000
  GOTO CrossHair

  END

' -----[ Subroutines ]-------------------------------------------------
'
ShowChar:
  FOR col = 1 TO 5    .                            ' character is 5 columns wide
    READ (eeAddr1 + col - 1),d7219                  ' read column data from EEPROM
    SHIFTOUT Dpin,Clock,MSBFirst,[col,d7219]
    PULSOUT Load,3
  NEXT
  RETURN


ReadJoyStick:
  HIGH JoyX                                         ' discharge RC caps
  HIGH JoyY
  PAUSE 5
  RCTIME JoyX,1,joyXval                             ' read x axis
  RCTIME JoyY,1,joyYval                             ' read y axis
  RETURN
```

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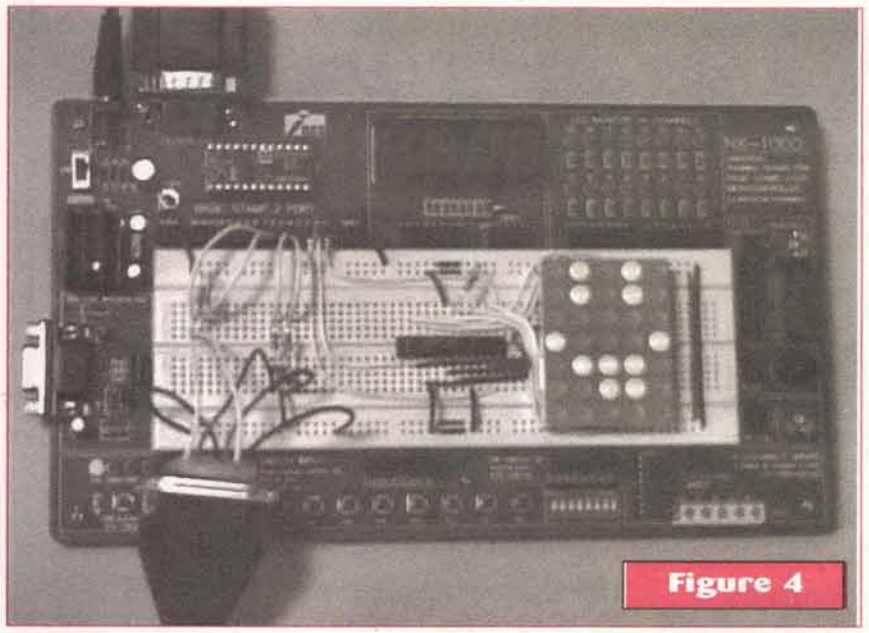

Figure 4

display.

The final section of the program, **Crosshair**, reads a PC joystick and creates a display on the fly. When the joystick is centered, a crosshair is drawn on the LED matrix. If you move the joystick left or right, the vertical line moves left or right accordingly. If you move the joystick up or down, the horizontal line follows.

Pressing the X-axis button causes a smirky smiley face to be displayed. Pressing the Y-axis button starts the program all over. Okay, let's look at the crosshair display.

The first thing we do is grab the buttons. Since the two inputs are pulled up, they'll read as one when open and zero when closed. The buttons are connected to the upper two inputs of the input nibble, so the data is shifted right twice and inverted to give it positive logic. The upper bits of the shifted data are masked out so our final value has a range of zero to three.

The buttons value is used in a **BRANCH** table to control the flow of this part of the program. If the X button is pressed, the value will be one and the code will jump to the label called **ShowSmile**. The code here is very straightforward. It simply points at a custom character definition and displays it (you can see the smiley in Figure 4). After a short delay, the program loops back to the button check.

If no buttons are pressed, the code drops through to the crosshair display at **ShowTarget**. This code uses the subroutine, **ReadJoyStick**, to grab the pot values from the joystick using **RCTIME**. If you decide to port the code to one of the faster Stamps (BS2sx or BS2p), you'll need to double-check the JoyXMax and JoyYMax values. You should probably do this anyway since my joystick is very old and may use non-standard values.

Okay, we know where the stick is pointing by reading the two pots, now we need to convert this into row and column data for the crosshair display. This is easy, we simply need to divide the current reading by the respective value for each row or column

Resources:

Jon Williams
3718 Valley View Lane, #3040
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(972) 659-9090
jonwms@aol.com

Parallax
599 Menlo Drive, Suite 100
Rocklin, CA 95756
(888) 512-1024
www.parallaxinc.com

With the Y-axis value, we'll use a **LOOKUP** table to get the column data – the lit dot corresponding to the up-down position of the joystick. By using the same value all the way across the display, a horizontal line is drawn. When we get to the column that corresponds to the X-axis value, we fill it with ones, creating a vertical line. It's deceptively easy.

You may be wondering about the LED matrix being connected directly to the MAX7219 without any current limiters (resistors) in between. The current to the LEDs is actually controlled by the MAX7219 and is set by the 10K resistor on Pin18. At 10K, the current to each segment is about 40 mA. With seven LEDs in a column lit, this adds up to about 280 mA (total current draw is also affected by the Intesity register value). This is why we need a separate power supply for the MAX7219 – there's no possible way for the Stamp regulator to supply this kind of current.

Taking It Further

If you're using a BS2sx, BS2e, or BS2p, you can take advantage of the extra EEPROM space and define an entire custom character set. Using simple math, it would be very easy to convert the characters in a text string to EEPROM addresses for your characters. With a little effort, you could extend this month's demo into a single-character, scrolling message board. Are you up to it? Of course you are – and have fun doing it.

Until next time, Happy Stamping. **NV**

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Amateur Robotics

by Robert Nansel

Chaos at the Robot Ranch? I never knew the meaning of real chaos before this week.

You see, as I write, my wife Shoshana is in early-stage labor – this a week before the baby is due. Was due. Apparently babies have no respect for magazine deadlines (sorry Robin!).

We have everything packed and ready to go the instant the nurse midwife tells us it's time. But it's a hurry-up-and-wait sort of situation, so I write a little, check with Shoshana, check the fridge, write a little more. If this column seems somewhat frenetic or disjointed, I can only plead severe distraction.

So. First, I have a few words to say on the progress of Heavy Iron, my hobbyist CNC project. Next, I'll talk a little about my latest obsession: free-range solar-powered robots. Finally, I'll wrap up with my pick for Robot of the Month: Tryclops, a beautifully crafted holonomic drive robot designed and built by Brynn Rogers.

I won't have anything to say about melting aluminum (I'm still building the crucible furnace), and Jiffy only gets passing mention.

Heavy Iron

Figure 1 shows the various electronic and electro-mechanical subsystems required for a CNC machine, a road map for the project. However, for this and the next few columns, I will be concentrating on the mechanical fabrication details, some of which are shown in Figures 2 and 3. As with most large projects, this one is taking more time than I'd planned, but I can give you a short progress report.

First of all, I'm using some surplus steppers from C&H Sales (www.candhsales.com), stock #SSM9900, $57.50 each. These are four-phase, 200 step/rev motors with eight leads that can be connected for bipolar operation. They are rated at 140 in-oz torque, 1.8A/phase. Unfortunately, C&H doesn't have a lot of these motors in stock, so call before you order. They do have other suitable motors, such as SSM9254A, SSM9250, and SSM2050. Another place to look for steppers includes Dan Mauch's webpage (www.seanet.com/~dmauch/), where you will also find the three-axis stepper motor driver kit I am using.

As far as motors, what you want are at least 100 in-oz steppers, 180 to 200 steps per rev. With 100-150 oz-in steppers (NEMA 32 frame) and the right spindle motor, you'll be able to machine with a 1/2" end mill using light cuts at about 4-5 inches per minute. With a slow enough spindle drive speed, you should also be able to use a fly cutter (single cutting point) to cut wide, flat swaths if you take light enough cuts. It depends, of course, on what kind of spindle motor you use, feed, speed, etc.

Since Heavy Iron's first incarnation will be as a simple printed circuit board drill and router, it will use a ball-bearing Dremel drill since they are readily available, inexpensive, and adequate for the task. For heavier machining in metal, though, you'll want a 1/4 to 1/2 HP spindle drive with a countershaft to give a variety of speed reductions.

Second, I decided to scrap the Harbor Freight Cross Slide vise and go with the smaller Enco X-Y table for my Z-axis.When I took apart my vise, I found the leadscrews aren't even straight, and the threads are quite rough. I ordered the Enco unit to save myself the time and money I'd otherwise spend correcting the defects of the Harbor Freight vise. As it turned out, the smaller Enco X-Y table (model #201-2826) was still on sale after the start of the new year for $66.95 US (normally $99.95), so there's an excellent chance folks interested in using it for this project can get one for the sale price.

It's really quite nice and well machined, especially compared to the Harbor Freight vise. At $66.95, it's a steal. You could even make a smaller, less expensive version of Heavy Iron by using two of these tables, one for the X and Y axes, and the other for Z. In fact, the smaller X-Y table actually has more useful cross travel (Y-axis) than Enco's model 201-2536 table.

For attaching the motors to the Enco tables, I'm using flat aluminum brackets, fairly easy to machine by hand. The X-Y table and the column will be bolted to a rigid bed made from a 24"-long piece of hot-rolled steel channel, 10" x 3" x 0.5". The column to support the Z-axis is a 24-inch tall rectangular steel tube, 6" x 4" x 0.25". The column is bolted to the bed with 2" x 1/4" angle with 0.25" steel dowel pins for precision alignment.

I ordered my steel from MetalsDepot (see sidebar). The prices were competitive with local suppliers, though if you can find scrap pieces the right size, that will

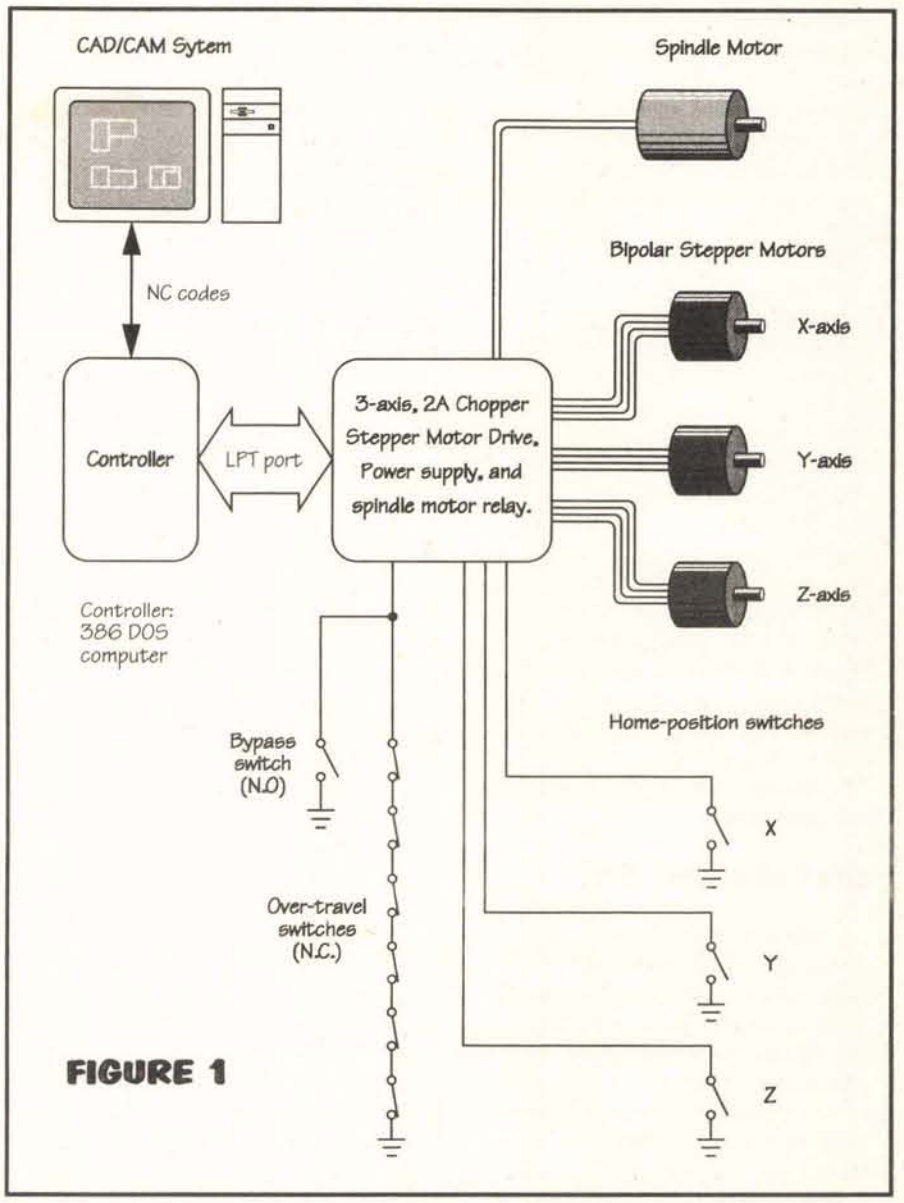

FIGURE 1

CNC Resources on the Web

Arrick Robotics
PC-Based Motion Control Products
www.robotics.com/index.html

Camtronics
Dan Mauch's line of stepper motor driver cards, as well as stepper motors and assorted CNC pointers.
www.seanet.com/~dmauch/

CNC Easter egg decorator
http://www.iaxs.net/~bshapiro/eggmac.htm

CNC Retro-Fit Links
www.mendonet.com/cnclinks/

Computers and Sculpture
www.computersculpture.com/Computer_resources.html

Enco
1-800-873-3626
www.use-enco.com

Herbach and Rademan
Surplus electro-mechanical and scientific stuff. Good source for stepper motors.
www.herbach.com

Home Build Hobby Plotter/Engraver
home.soneraplaza.nl/mw/prive/luberth/plotter/plotter.htm

Make your Own Engraving Machine or Plotter
www.majosoft.myweb.nl/index.html

MAXNC, Inc.
For those of you who want a commercial CNC machine, MAXNC has a number of light-duty CNC mills and lathes starting at $895.00.
www.maxnc.com

MetalsDepot
Buy small quantity metals online
www.metalsdepot.com/index.phtml

San Diego Motion
home.att.net/~sandiegomotion/index.html

ShopBot
CNC WorkShop RoBot
www.ShopBotTools.com

be far cheaper. MetalsDepot doesn't stock a 10" x 3" x 0.5" channel (I got mine as scrap locally – after I'd already ordered from MetalsDepot), but they do have a 10" x 2.74" x 0.379" channel that will also do.

Even new, hot-rolled steel is pretty rough stuff; its dimensions are only approximate and it comes coated with mill scale. To achieve the level of accuracy and precision required for a full metal milling machine, some machining is needed to true up the top surface of the bed. This can be done either by hand with a cold chisel and a file, or you can send it out to be planed at a local machine shop (the cost for the latter is about $50.00 in my area). If all you are interested in is the printed circuit board driller/router, then you won't need as much precision, so you can get by with a little filing and shimming.

Anyway, lots more on all this next time.

The Call of the Wild

My reason for building Heavy Iron is so I can build more robots, both their printed circuit boards and parts that require lots of repetitive machining. As I've mentioned in the past, I'm interested in cooperative robotics where large numbers of small robots perform tasks through simple, well-defined robot-robot interaction rules, much like social insects in the biological realm.

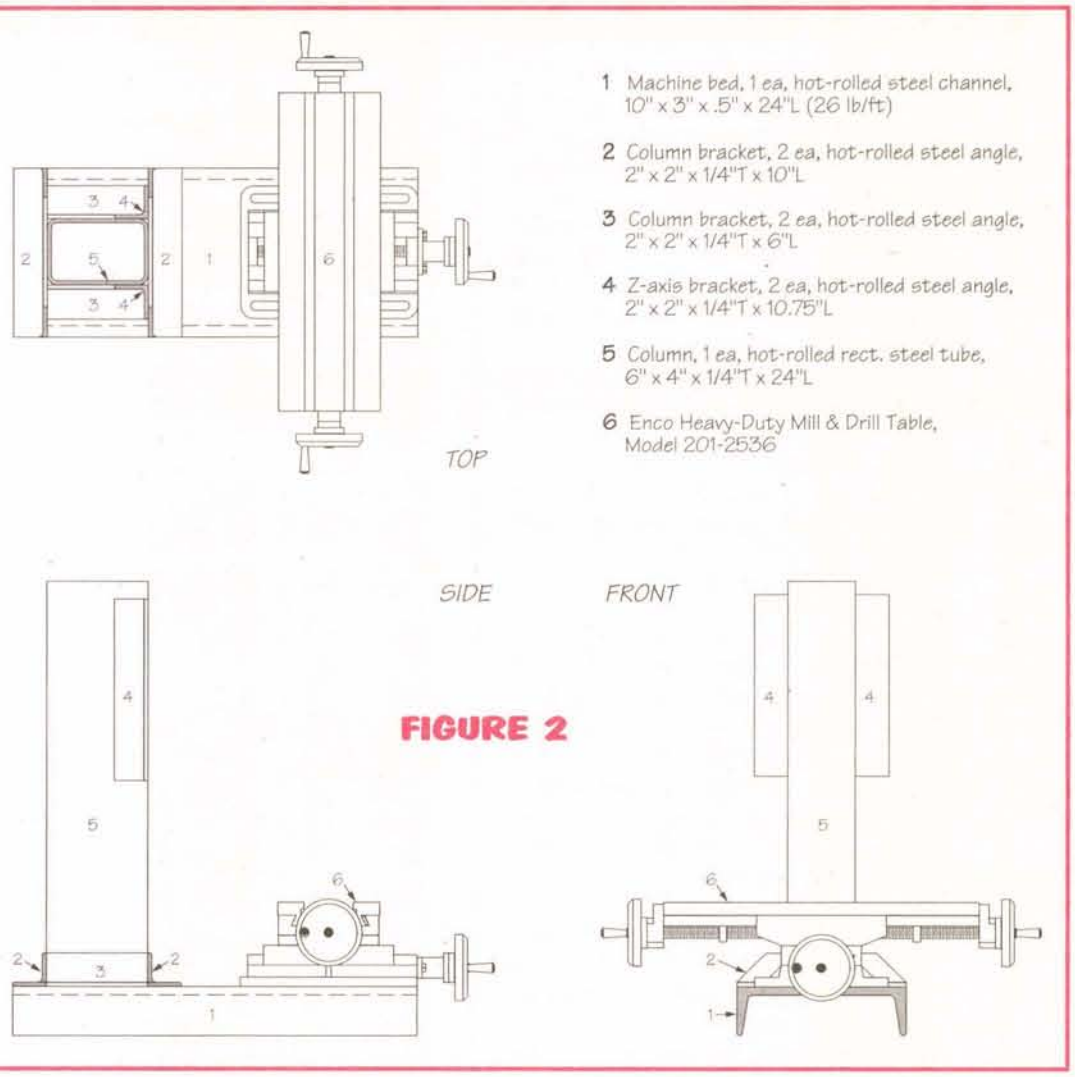

FIGURE 2

BEAM-style robots are a natural for this sort of experimentation because they are small and cheap, so you can afford to build a lot of them and they'll fit on a desktop. I've got several BEAM robot projects in mind this year. (If you've never heard of BEAM robotics, check out the following links to get you started: http://www.solarbotics.com, http://beamlinks.botic.com/, and http://people.ne.mediaone.net/bushbo/beam/FAQ.html.)

Another type of robot fascinates me these days, though, and they are the polar opposite of social insect robots, being solitary like turtles or hermit crabs. What captures my imagination about them is they are meant for independent operation in harsh environments. Among the new robot projects I'm contemplating for the coming year is a robot series designed to function unattended 24/7 in one of the harshest environments I have handy: my backyard. This is something I haven't seen anyone really do yet (certainly not in my backyard).

I don't want these robots to mow the lawn, I don't need them to fetch me a beer, and they don't need to cram VGA-quality video through a 9600-baud pipe. In fact, they don't need to do anything at all beyond move around as required in response to changes in their environment. I'd like these robots to emulate wild animals as close as possible (within the limits of current technology, of course – they won't be able to repair themselves, nor will they reproduce). If I can toss one of these robots out in my backyard and come back a year later and the robot is still moving around, still responding appropriately to its environment, then I'd say that would be a pretty fine achievement. Maybe even useful. Certainly educational.

Robots in the Weeds

I am calling this robot series "Tall Grass," and I want them to ultimately have a functional endurance

of 10,000 hours – about 416 days – with no human intervention or maintenance. Tall Grass robots must be designed to survive for more than a year of summer heat, winter cold, high and low humidity. Further, they must cope gracefully with grass, dandelions, a few smallish stones, curious animals, rain, snow, wind, etc. I want them to monitor and respond to changes in their environment, the quantities of interest being temperature, light, touch, and sound. I might also want to add a pick-up coil and circuitry to them to detect an electronic boundary wire to keep them in my backyard (though it might be easier to just complete fencing in the yard).

Like a BEAM robot, these machines will be solar powered, but since I want to reliably be able to find them to check their condition, they must be bigger than a typical BEAM photovore. Otherwise they would simply disappear in the grass. For this reason, the 'bots would have a footprint somewhere between 6" and 12" square. For the sake of discussion here, I'll suppose each robot's power source will be limited to a battery charged by a solar panel about 6" square, sufficient to produce around 500 mW at noon on a clear summer day.

Now 500 mW is peak power, but the total power budget is determined by the average power available over the course of a day and must include allowances for night, cloudy days, and battery and DC-converter losses. Being conservative, I'm figuring on about 274 watt*hr/sq. meter/day (see solar power sidebar), so my little 6" panel – about 0.0232 sq. m – would be able to deliver around 6.4 watt*hr/day on average throughout the year. That means keeping the average power consumed well below 265 mW. For a 5V system, that corresponds to about 53 mA average current consumption.

Obviously these robots aren't going to move very far or fast, but they must move at least a little to stay out of shade to keep from starving. They will have to have some kind of energy storage onboard, a combination of high-value capacitors and rechargable batteries, and they will be designed to use very, very little power. Even so, they will have to spend most of their time sunning themselves and will generally move only at a turtle's

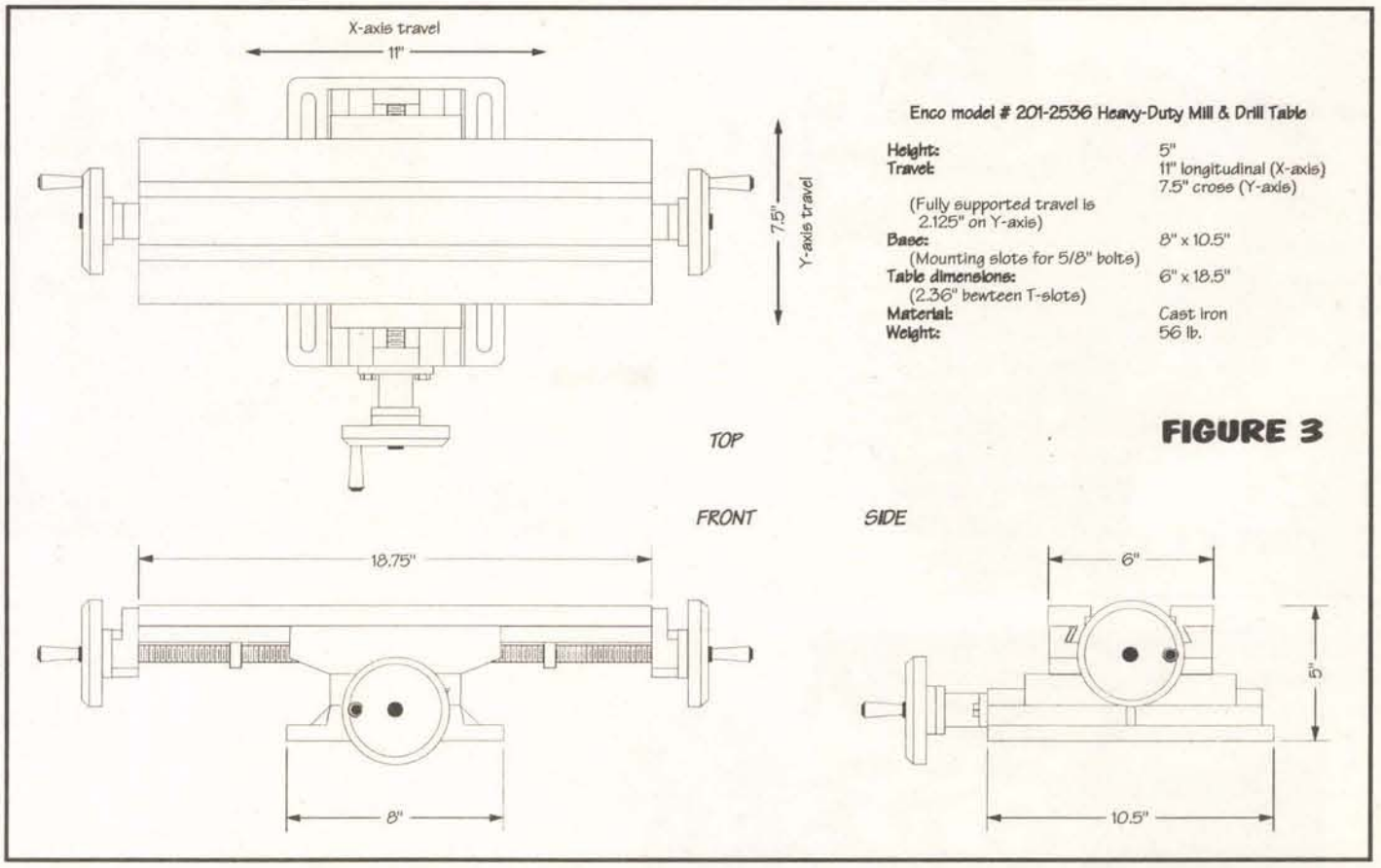

FIGURE 3

End-to-End Solar Electric Power Calculations

How much solar power a photovoltaic system can produce depends on a bunch of factors, but the main ones are P.L.A.C.E.: Panel tilt, LAtitude, Climate, and Efficiency.

I gleaned the following data from the Solar Radiation and Climate Database available online at Solstice (http://solstice.crest.org/renewables/solrad/index.html). Solar radiation for a non-tracking, horizontal flat-plate collector in the Pittsburgh area (the numbers are in units kW*hr/m2/day):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Ave	1.7	2.5	3.5	4.6	5.5	6.1	5.9	5.2	4.2	3.0	1.8	1.4	3.8
Min	1.4	2.2	3.0	3.5	4.5	5.1	5.2	4.7	3.7	2.5	1.5	1.2	3.6
Max	2.0	3.1	4.2	5.4	6.2	6.8	6.7	5.8	4.9	3.8	2.1	1.6	4.0

Now, to calculate power available to my robot I'll assume the following:
- (3.8 kW*hr/m2)/day insolation, the yearly average for my area.
- 10% overall panel efficiency; high-performance PV panels can give above 14% efficiency, but I'll stick with 10% in the following calculations to be conservative.
- 80% battery efficiency; in order to get 100 watt*hr out of a battery, you have to put about 125 watt*hr into it.
- 90% DC-DC converter efficiency.

Average energy available then becomes: (3.8 kW*hr/m2)/day x (.10) x (.80) x (.90) = 273.6 W*hr/m2/day

Average power available from the robot's 6"-square solar panel: (273.6 W*hr/m2)/day x (0.02322 m2) x (1 day/24 hr) = 264.7 mW

At 5V, this corresponds to an average current draw under 53 mA. In December, however, when the insolation is as low as 1.2 kW*hr/m2/day, the power would be less than a third of the yearly average, which is about 84 mW, or 16 mA at 5V.

If I arbitrarily allocate 10% of the average power to the robot's electronics and devote the remaining 90% to propulsion needs, then my robot has an average of 238 mW to move around with. That means that, in the course of a day, the robot can rely on no more than 236 mW x 24 hr = 5.7 W*hr each day.

Suppose the robot uses four 12V motors, each drawing 130 mA under load; that's a total load of 520 mA and represents a power drain of 6.24 W. With just 5.7 W*hr of energy available to it during a day, the robot could be in motion for (5.7 W*hr) / (6.24 W) = 0.92 hr, about 55 minutes of that time. In December, however, the robot's roving time would be cut to just 17 minutes a day if the robot couldn't rely on charge saved up from previous months.

A compensating factor is that it won't always be necessary for the solar electricity to go into the batteries where 20% gets lopped off in charge/discharge losses. If the robot is designed to move mostly during the day when sunlight is available, then the solar panel can provide that power directly to the DC-converter without incurring the battery efficiency penalty. Likewise, the robot would realize another 10% efficiency gain if the motors can run directly from the solar panel voltage. Running directly from the solar panel without intermediate battery and DC-converter losses gives the robot an effective efficiency boost of 28%. The lesson here is that a solar-powered machine is at its best when it uses power while the sun shines.

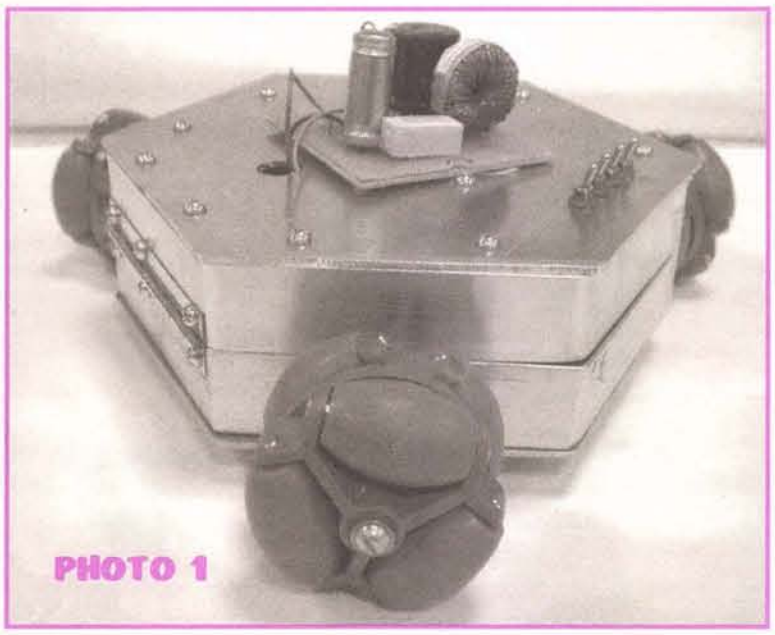
PHOTO 1

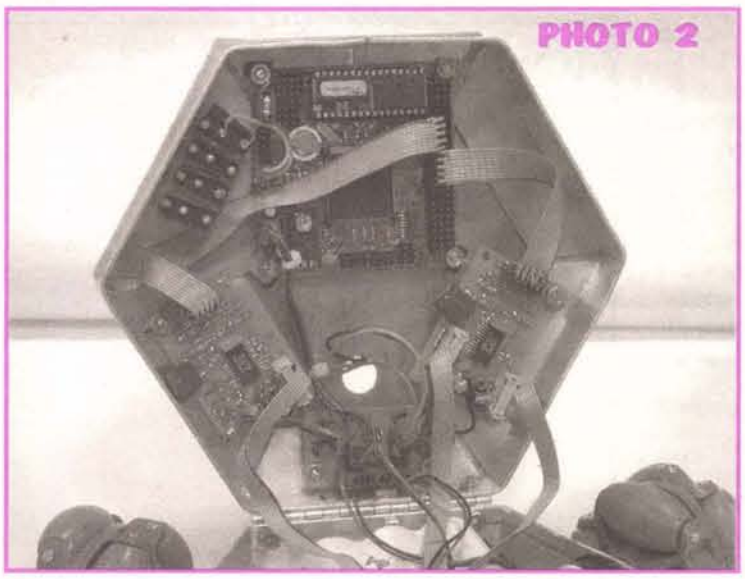
PHOTO 2


PHOTO 3

pace to keep out of shade, and that only during the day. But it would be nice if they had a top emergency speed of, say, 1 ft/sec if they hear a lawn mower approaching.

Life, Death, and Robots

I'll start with a Jiffy-style skid-steer 4WD system, but later Tall Grass robots will likely be walkers. Reliability and simplicity are the top two considerations, but cost is a close third (below $1,000.00 is acceptable, but below $500.00 is more my range).

All relevant sensor readings and behaviors would be logged every 10 seconds, say, so when a prototype dies – and they will die often and early – I can try to reconstruct what happened to cause the failure. This data logger, strictly speaking, won't be part of the robots. Think of it as a flight recorder, maybe with its own power source. Uploads should take place at least daily to keep the data logger memory small, probably less than 32K.

A direct cable link for uploading data would be simple and cheap, but it would require a hi-rel connector and, perhaps most problematic, a hi-rel me (I would have to remember to go out and find the beasties every day). Wireless, on the other hand, while amenable to automation, takes precious power, adds cost and complexity, and is subject to interference. Still, it shouldn't ever have to transmit further than 50 feet, line-of-sight (my backyard is small). And if something goes wrong, I stand a chance of finding out sooner rather than later if it does hourly uploads.

Even if the transmitter consumed 60 mW, sending 1K bytes of data at 1200 baud once an hour (which would take about 8.5 seconds with no error checking), it would need an average power of just 142 microwatts provided the transmitter could be powered down between bursts. That seems do-able.

The question then becomes, what is the proper tradeoff between data logger memory size and how often the data gets transmitted? A larger memory needs fewer, longer transmissions which would likely be more energy efficient, but the more frequent transmissions a smaller memory requires would give me more timely information when the 'bot is in difficulty.

Strictly speaking, this information wouldn't be used to rescue the robot (that would defeat the point of this project); instead I would use it to establish time and manner of "death." After a quick post-mortem, I would make suitable design changes and begin a new run.

I aired these ideas on several robotics email lists. The initial feedback I got from fellow gearheads was that this is an interesting and very ambitious project, perhaps not do-able with low-cost parts. Several people suggested it might be easier to build a central charging station with a homing beacon of some sort where the robot would "feed" and perhaps upload performance and environmental data.

I considered a home base with

charging facilities, but this has been done many times before. Even Dr. W. Grey Walter's turtle robots Elsie and Elmer from the late 1940s were able to recharge themselves in "hutches" when their batteries got low enough. I decided against it because I really do want to do the research to make a solar-powered "wild" robot feasible.

I am considering a passive shelter, however, an artificial safe haven for a Tall Grass robot to sleep when it's most vulnerable (when it's dark and/or cold). This would probably be little more than a ramped platform with a transparent overhang. I don't know how the 'bot would find it, though, since it probably won't be smart enough to recognize the shelter, at least not from a distance. I propose to make things easier by putting a low-wattage light bulb inside and let the robot's built-in phototropism lead it to the shelter at sunset. Then, too, the heat of the bulb would serve to ameliorate some of the temperature extremes.

Survival of the Fittest

The way I'm approaching this project is to first build an immobile solar-powered temperature data logger. I've already got a Malibu Solar Accent light to hack for this purpose. Using that experience, I'll attack the Tall Grass robots in stages with clearly defined intermediate goals. If I were to attempt immediately to build the 10,000-hour robot, I'd fall flat on my face because I don't yet know for sure what things will be important in the design.

Instead, to start, I will build a robot to survive my backyard for one hour. With a few sensors added, my Jiffy robot design can probably already meet this goal. The next robot would run for 10 hours without human intervention. Jiffy might also be able to do this, too, but it would have to do some creative power management to make its batteries last that long.

Next comes a 100-hour robot (solar power becomes essential at this stage), then a 1,000 hours, then the 10,000-hour goal. I'll start in Spring when conditions aren't so extreme, so maybe by the time the temperature extremes do come I'll have learned a thing or two (and maybe avoid a few expensive mistakes).

For convenience when talking about these machines, I've defined a logarithmic scale to classify my free-range robot experiments. The Survival Index Number (or just "S-number") is defined as S = Log10(T) where T = hours of continuous robot operation without human intervention. A one-hour robot would be an S0, a 10-hour robot would be an S1, a 100-hour robot S2, etc. My goal, restated, is to build an S4 robot, and I'll build successive S0, S1, S2, and S3 robots along the way to that goal.

By their very nature, S3 and S4 robots take a l-o-n-g time to test. I'm hoping the S0 through S2 robots I'll present in the coming months will be quick and fun projects. There will certainly be a lot of variety as I evolve different approaches.

Meet Tryclops

Speaking of different approaches, Photos 1 through 3 show another example of a holonomic robot drive system using roller wheels. The first example was at Carnegie Mellon, the so-called Palm Pilot Robot (now available as a kit from Acroname.com as the "PPRK"). This robot's name is "Tryclops," and I'll let Brynn Rogers tell its story:

"Tryclops can move in any direc-

tion without turning and can turn at the same time thanks to the 'one dimensional' wheels that have traction perpendicular to the axle, but low friction parallel to the axle. That is, the wheels operate as normal wheels but they may also slide laterally.

Tryclops sits about 2.75 inches high, the hexagon is 6.5 inches across, and the maximum dimension is nearly 10 inches from the edge of one wheel to the next.

In building Tryclops, I used a bandsaw and a drill press. The only machine work I have needed so far is to turn the wheel shafts on a Sherline lathe.

Power is provided by nine sub-C cells split into three three-cell packs which provide 10.8 volts. Currently, I am using the 7805 regulator on the MiniRoboMind to get five volts, and what you see on top of Tryclops is a 10.8V to 24V switching regulator that provides the higher voltage that my 18V motors need. I am currently working on a small board to replace my power distribution board (it has connectors but no active components) that will include both a 10.8V to 5V (1.5A) switcher, and a 10.8V to 24V (2 A) switcher.

To drive the motors, I made two dual H-bridge boards that are capable of handling four DC motors each 60V and 2.5 amps. This is overkill, because the motors in Tryclops are only drawing a couple hundred milliamps each, even when over-voltaged. The motors are Micromo 2233V018S with a 40.5:1 gear head and a 16 pulse per revolution encoder found at a surplus store for $12.95 each (no, they don't have any more!). The motors run 8700 RPM at 18V and put out 2 oz/in of torque before the gearhead.

The brain is a MiniRoboMind 68332 single board computer from www.robominds.com which runs at 25MHz and has a time co-processor that handles complex functions on 16 timer channels independent of the CPU32 core.

Sensors are the most important part of a robot and I decided that if I have one good sensor I can do away with trying to combine inputs from many different types of sensors. What I am building now is a laser range finder that will give me ranges from one to 10 feet with an accuracy of better than a half inch 64,000 times a second.

This range finder looks down on a spinning mirror that scans a full circle around the robot. The mirror needs to spin as fast as 1200 RPM. I have breadboarded various portions of this design and am now fabricating PCBs to hold the high frequency electronics."

[You can see the current state of Brynn's Tryclops and a seven Mbyte movie of it in motion at www.visi.com/~brynn/tryclops.]

The Cry of a Baby ...

I wish. By the time y'all read this the drama here at the Robot Ranch will all be over – and sleep deprivation will be in full swing. But as I write, we still haven't met our new baby. Any hour now ... **NV**

If you have suggestions, questions, or comments about amateur robotics topics, you can now reach me at:

Robert Nansel
Box 228
Ambridge, PA 15003

Email:
bnansel@nauticom.net

Continued from page 13

TERK INTRODUCES DIRECTV-COMPATIBLE SATELLITE DISH ANTENNAS FOR THE DBS MARKET

TERK Technologies has introduced two new DIRECTV-approved satellite dish antennas for the direct broadcast satellite (DBS) market. These dishes are compatible with all DIRECTV receiver modules that are designed to receive DIRECTV® programming.

The two new DIRECTV system-compatible satellite dishes from TERK are the TRK-S22 and the TRK-S2.

The TRK-S22 is an 18" x 24" reinforced weather-resistant antenna, with two dual LNDs and a four-output (4x4) multi-switch, for easy hook-up to as many as four receivers. The product comes complete with antenna; mount assembly including bracket, arm, mast, and base; cables (labeled in pairs for Sat A and Sat B) for do-it-yourself installation; and necessary hardware. Designed to be forward compatible, the TRK-S22 DIRECTV multi-satellite dish antenna works with high-definition broadcasts. It is available now for $149.95.

The TRK-S2 18" antenna features a dual LNB, which provides a simple installation process for consumers who are receiving DIRECTV programming from two receivers. The product also comes complete with antenna; mount assembly including bracket, arm, mast, and base; and necessary hardware. It is available now for $49.95.

As satellite services continue to broaden, consumer programming such as local channels, high definition broadcasts, data transfer, and interactive services will create a higher demand for DBS hardware. The new TERK disk antenna series will provide consumers new options based on their personal programming needs.

For further information on TERK products, log onto their web site at http://www.terk.com.

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RICHARD GRAY'S™ POWER COMPANY LAUNCHES MODEL 1200S, THEIR FIRST PRODUCT FOR BOTH AUDIO AND HOME THEATER

Audio Line Source, LLP announced the addition of the new Richard Gray's Power Company™ Model 1200S – a new, single-source, all-inclusive parallel power enhancer device.

The 1200S supplies cleaner power to multiple components for both audio and home theater applications. One RGPC 1200S offers the power of the two RGPC 400S' in a shelf or rack-mountable unit.

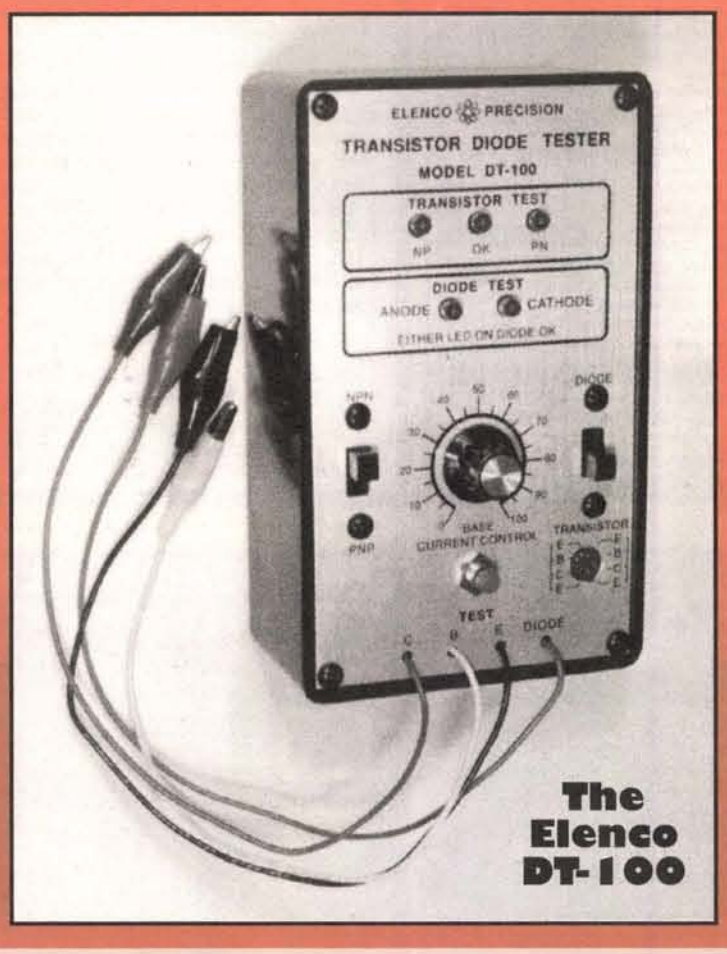
The RGPC 1200S provides video images with more vibrant colors and better black level detail in all video formats, including high definition, for increased front-to-back dimensionality. It reduces video noise generated by line-multipliers and related digital and analog components, and may be used with the largest amplifiers and powered subwoofers. Its "Electric Flywheel" effect stores and instantaneously releases energy on-demand to supply energy to components that are often starved for current by the resistance on a soft A/C line. The RGPC 1200S eliminates A/C line noise, internal cross talk, and reflected back EMF without current limiting. Its unique design makes it an effective surge protection system.

Unlike traditional power line conditioners, isolation transformers, and sinewave amplifiers (regnerators), which are wired in series, the 1200S is wired in parallel to the source of power and does not limit valuable current necessary to satisfy power transients required of the A/C line. Built with 12 Hubbell outlets and a 20-amp system, the 1200S may be linked together in a "star-cluster array" to achieve greater incremental improvements in most systems. Its suggested retail price is $2,000.00.

For more details, go to http://www.richardgrayspowercompany.com or call Audio Line Source, LLP at 504-897-6688 or toll-free at 1-800-880-3474.

by Fred Blechman

Using the Elenco Model DT-100 Transistor Diode Tester



The Elenco DT-100

Probably among the most-used components in experimenter and hobbyist electronic circuits these days are transistors and diodes of various types. The transistor tester described here dynamically checks most kinds of transistors and diodes. It can be built from a kit or purchased assembled.

Transistors and diodes are used in just about every electronic circuit these days — even those that use integrated circuits as their main elements. Among their many functions, diodes are used to direct current flow, and transistors are used as amplifiers and drivers. While simple static go/no-go testing can be performed with an ohmmeter and some knowledge of function, dynamic testing actually puts the component to use. The Elenco Model DT-100 transistor diode tester uses dynamic testing.

The assembled Elenco Model DT-100 transistor diode tester sells for $31.95. It is also available as the DT-100K in kit form for only $23.95. This professional-looking piece of test equipment comes in a four- by six- by two-inch black plastic case with a gold anodized cover plate silkscreened with clear black markings.

An eight-pin socket allows testing of smaller transistors with any of the six possible lead positions; three colored external clip leads are used for larger components. A fourth clip lead is used for diode testing. A push-button test switch is operated when the component is connected and the NPN/PNP and diode/transistor slide switches are set.

The results are displayed by the proper glowing of three LEDs for the transistor test, or two LEDs for the diode test. A rotary base current control provides a means for roughly matching the gain of similar transistors. Power is provided internally by a common nine-volt battery.

The DT-100 can check most types of diodes — germanium, silicon, power, LED, and zener — out of the circuit, and in-circuit with resistors as low as 5,000 ohms. The diode test also automatically identifies the anode and cathode.

Most types of transistors — germanium, silicon, power, RF, audio, switching, FET — can be tested out of the circuit, and in-circuit with base or collector resistors as low as 100 ohms. The transistor test also identifies NPN and PNP types, and the relative gain of two transistors.

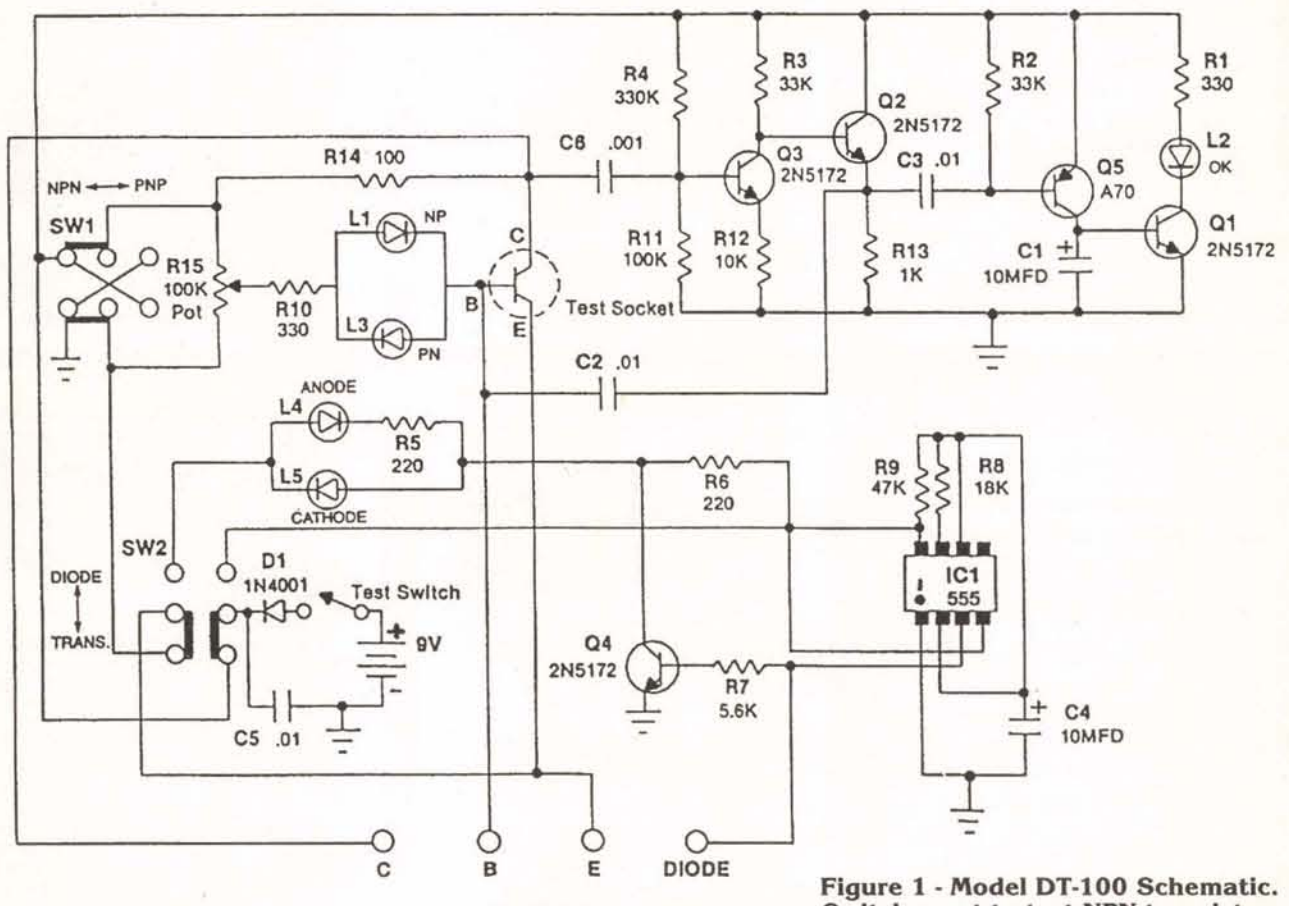


Figure 1 - Model DT-100 Schematic. Switches set to test NPN transistor.

Kit or Assembled?

Although this kit is not difficult to assemble, it will take 1.5 to 2 hours, a soldering iron with a small tip, and some previous experience soldering parts with leads close together.

The printed circuit board (PCB) and all components are of excellent quality. The component side of the printed circuit board is silkscreened in white to show component locations, and the solder side is coated with a green no-solder mask to prevent solder bridges between close leads. The 10-page *Assembly and Instruction Manual* is clearly print-

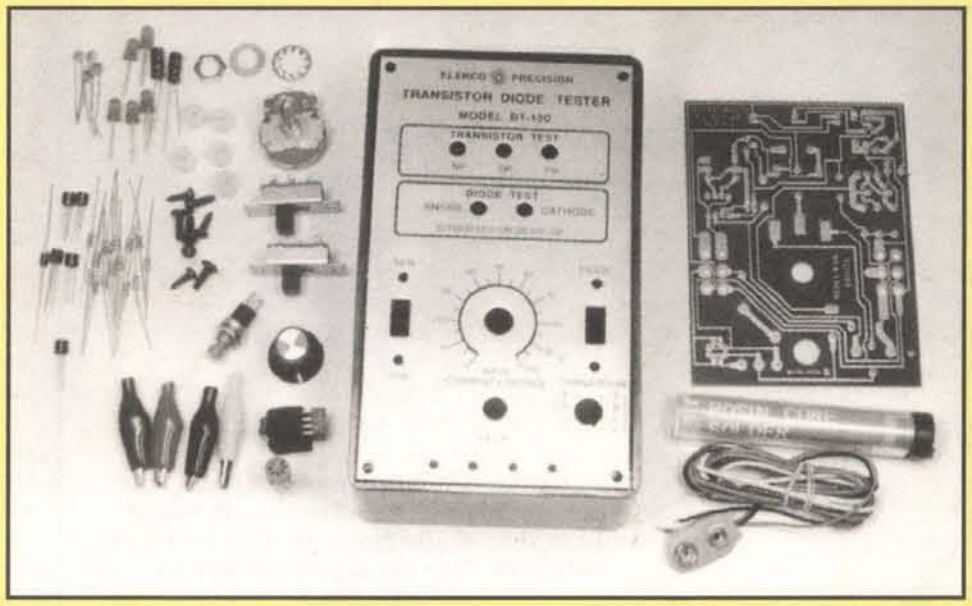
Using the Elenco Model DT-100 Transistor Diode Tester

ed with many illustrations, and takes you step-by-step through construction, testing, and troubleshooting.

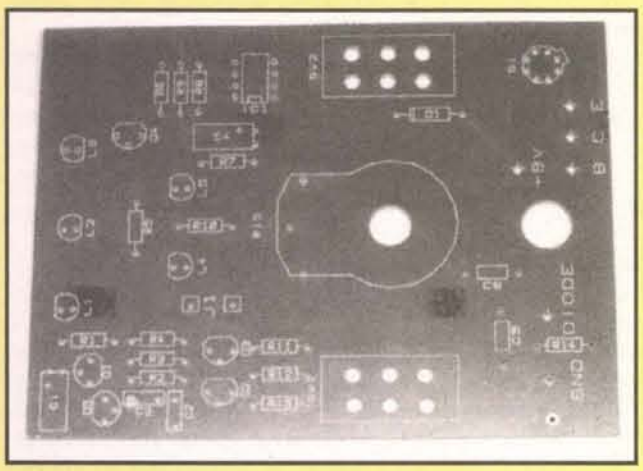
However, the manual is not very explicit about circuit operation, and typical uses are confusing, so we'll address those items here.

Incidentally, troubleshooting an improperly assembled kit can be very difficult with this design, since all the components are sandwiched between the PCB and the front panel; you only have the printed circuit side of the board to work with, and hardly any place to clip test leads. All in all, for the small extra $8.00, I'd suggest you purchase the assembled unit unless you enjoy building kits and then troubleshooting them.

Of course, the assembled kit requires no troubleshooting if it doesn't work properly, since it is guaranteed by Elenco. Later on, we'll cover using your DT-100 for proper operation — kit or assembled unit. But first, we'll take a look at how the circuitry works.



All parts, including solder, wire, clips, and a fully silkscreened gold-anodized front panel, are included in the $23.95 kit.



The high-quality etched and drilled printed circuit board has white silkscreened part locations on the component side. The etched side has a green no-solder mask to virtually eliminate soldering bridges.

Theory of Operation

Figure 1 shows the schematic of the Model DT-100. SW1 is the NPN/PNP slide switch, shown in the NPN position. SW2 is the diode/transistor slide switch, shown in the transistor position.

For the purpose of explaining circuit operation, assume an NPN transistor is plugged into the test socket (or using the external C, B, and E test leads), and that the leads are properly oriented — that is, that the test transistor collector, base, and emitter leads are properly connected to the C, B, and E test points, respectively.

When the push-button test switch is closed, positive voltage is applied through diode D1, through SW2, and through SW1 to the top of base current control potentiometer R15, and (through resistor R14) to the collector of the test NPN transistor. This also positively charges capacitor C6. Positive voltage also goes to resistors R1, R2, R3, and R4, as well as the collector of NPN transistor Q2, and the emitter of PNP transistor Q5.

If the setting of R15 allows enough test transistor base current to flow through resistor R10 and NP LED L1 (even though L1 may not glow perceptively), collector-to-emitter current will flow. Since the emitter is connected to circuit ground through SW2 and SW1, the voltage at the collector drops toward ground, quickly discharging capacitor C6, after which it recharges more slowly through R14.

The dynamic testing is accomplished by making the test transistor operate in an oscillator circuit. NPN transistors Q2 and Q3, and their associated resistors (R3, R4, R11, R12, R13), are wired as amplifiers, triggered by the fast discharging and slower charging of C6. The output of Q2 at its emitter is fed back to the base of the test transistor through capacitor C2. This positive feedback maintains oscillation. The frequency of oscillation increases up to about 20KHz as base current to the test transistor is increased.

At the same time, part of the Q2 emitter output is fed to the base of PNP transistor Q5 through capacitor C3. Here, resistors R2, R1, capacitor C1, and transistor Q1 form a driver circuit to switch on the OK LED (L2) to light only when there is oscillation. If test transistor saturation is reached, oscillation stops and the OK LED goes out.

When measuring PNP transistors, the power polarity supplied to the test transistor is reversed via the NPN/PNP switch, so base current flows through PN LED (L3) instead of L1.

Rotating the base current control clockwise from full counter-clockwise changes the voltage at the wiper, and increases the test transistor base current. The lower the base current for the OK LED to glow, the higher the gain (beta) of the transistor under test. Comparative tests of the gain of two transistors can be made by observing the dial setting to provide similar intensity of the glowing OK LED.

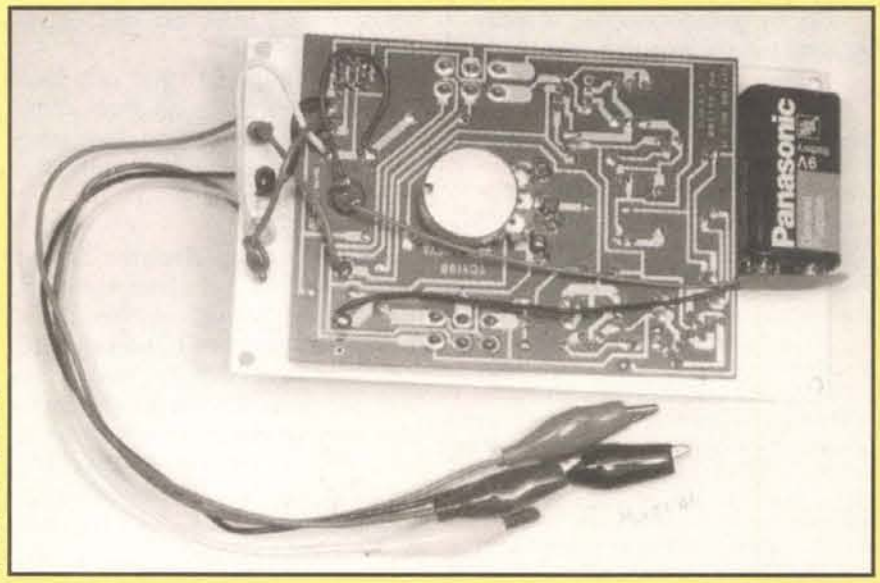
It should be noted that as the base current is increased by rotating the base current control clockwise, the NP LED will glow when an NPN transistor is under test. Similarly, the PN LED will glow with a PNP transistor under test. In both cases, the OK LED may go out if the test transistor enters saturation and stops oscillating.

The design configuration is such that in-circuit transistors can be tested provided that the base and collector resistors are greater than 100 ohms. However, it can often be difficult to access the leads of in-circuit transistors, and even more difficult to determine sneak circuit paths to other components that may lower the base or collector resistance below 100 ohms.

For testing diodes, slide switch SW2 is set in the diode position. SW1 may be in either the NPN or the PNP position. When the test switch is pushed, positive voltage is applied through diode D1 and SW2 to power pin 8 of IC1, a 555 timer/oscillator integrated circuit. Resistors R8 and R9, and capacitor C4, set the 555 to alternate from about supply voltage (HI) to circuit ground (LO) at output pin 3 about twice per second.

To explain circuit action, assume a test diode is connected so that the red diode test lead is clipped to the test diode anode, and the E test lead is clipped to the cathode of the test diode. As IC1 oscillates, every time a HI appears on pin 3 of IC1, the positive voltage travels through the test diode and appears (through SW2) at anode LED L4. Positive voltage also appears at the base of NPN Q4 through resistor R7, allowing Q4 to conduct and effectively bringing its collector to ground. This allows L4 to light through dropping resistor R5.

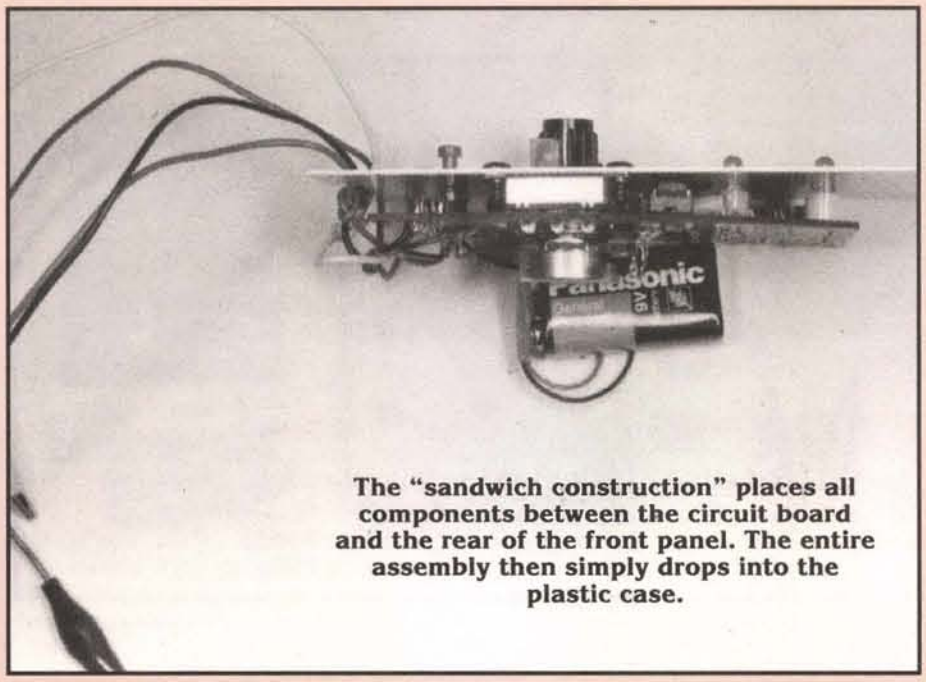
In the next half-cycle of IC1,



All components are mounted on the printed circuit board, which is then mounted to the front panel.

Using the Elenco Model DT-100 Transistor Diode Tester

Using the Elenco Model DT-100 Transistor Diode Tester



The "sandwich construction" places all components between the circuit board and the rear of the front panel. The entire assembly then simply drops into the plastic case.

when pin 3 drops to ground, Q4 is cut off, and no positive voltage at the test diode anode means it is not conducting. L4 goes out, then comes on again when pin 3 of IC1 goes HI in the next half-cycle. In other words, anode LED L4 blinks on and off.

If the test diode is connected so the diode test lead is clipped to the cathode and the E test lead is clipped to the anode, the circumstances are changed. When the test switch is closed, positive voltage from the battery, through diode D1 and switch SW2, appears at dropping resistor R6 and cathode LED L5. Since L5 is connected to the E test lead through SW2, whenever the output pin 3 of IC1 goes LO, it provides a ground through the test diode to light L5.

When pin 3 goes HI, transistor Q4 conducts, effectively removing positive voltage at L5, so it goes out. Again, the result is a blinking LED, but this time it is the cathode LED blinking, which means the red test diode test lead is connected to the cathode of the test diode. Simple, but ingenious.

So, by just connecting a diode between the diode and E test leads, the blinking LED will tell you if it is working properly, and its polarity.

All types of diodes may be tested: silicon, germanium, LEDs or zeners over six volts. Zener diodes under six volts cause the second LED to glow at lower intensity, indicating that zener breakdown has occurred.

Source

The Elenco Model DT-100 Transistor Diode Tester is available as a kit or assembled. The kit is the Model DT-100K and sells for $23.95. The assembled unit is the Model DT-100, and sells for $31.95. Both are available from **C&S Sales**, 150 W.Carpenter Ave., Wheeling, IL 60090. Add $5.00 for shipping, and 8.25% state sales tax if shipping to Illinois. Call **1-800-292-7711** or **847-241-0710**, or fax **847-541-9904** to order, or to request a free 60-page catalog loaded with test equipment and kits from major manufacturers. You can also order from the C&S website: **www.cs-sales.com**. The email address is **info@cs-sales.com**.

Testing the Model DT-100

If you build the DT-100 from a kit, you'll certainly want to perform the following tests to be sure it's operating properly. If you purchase the DT-100 assembled, you'll still want to run these tests.

A standard nine-volt 2U6-type radio battery is used inside the DT-100. You simply connect it to the battery clip and anchor the battery to the bottom of the case with double-sided tape. The battery should be good for many hours of testing.

Diode Circuit Tests: Place the diode/transistor switch in the diode (up) position. Connect the red and black clip leads together and push in the test button. Both diode test LEDs should blink on and off at about a 1-Hz rate.

Next, connect the red and black leads to any good diode. Only one LED should blink. Reversing the leads should cause only the other LED to flash.

Transistor Circuit Tests: Place the diode/transistor switch in the transistor (down) position. Short the yellow (B = base) and black (E = emitter) leads together and rotate the base current control fully clockwise. Press the test button. With the NPN/PNP switch set to the NPN position, the NP LED should light. With the switch set to the PNP position, the PN LED should light. Now, disconnect the yellow and black leads.

Rotate the base current control to the fully counter-clockwise position. Set the NPN/PNP switch to NPN, keeping the diode/transistor switch in the transistor position. Next, place a known good NPN transistor in the test socket with the collector in C, base in B, and emitter in E — or use the external C, B, and E clip leads. Be sure none of the leads are shorting.

Press the test switch and slowly rotate the base current control. The OK LED should light, indicating the test transistor is oscillating. The higher the gain of the transistor, the less you should have to rotate the control before the OK LED comes on. As you rotate the control further clockwise, the NP LED will come on as the base current increases, and the OK LED might go off.

Repeat this test with the NPN/PNP switch in the PNP position, and using a known good PNP transistor. The results should be the same, except the PN LED will come on as the control is turned clockwise.

Troubleshooting

If you purchase the DT-100 as a kit, the *Assembly and Instruction Manual* includes a troubleshooting guide based on the test symptoms. There's no need to repeat that here. If you bought the DT-100 assembled, Elenco will repair or replace it if it is defective.

Using the DT-100

Now that you've tested the DT-100, using it is fairly obvious. To be sure, here are step-by-step procedures:

To test diodes:

1. Place the diode/transistor switch in the diode position.
2. Connect test diode to red and black leads.
3. Press test button. One diode LED (anode or cathode) should blink. The blinking LED tells you which lead of the test diode is connected to the red diode test lead.
4. If both LED lamps blink, then the test diode is shorted.
5. If neither lights, then the test diode is open.

To test transistors out-of-circuit:

1. Place diode/transistor switch in transistor position.
2. Place the NPN/PNP position in the proper position for the transistor to be tested. If not sure, see later step.
3. Place test transistor in socket or attach to C, B, E leads. If collector C, base B, and emitter E are not known, assume B is the center lead on small plastic transistors and C the metal case or tab on power transistors.
4. Rotate the base current control fully counter-clockwise.
5. Press test button. If either the NP or PN LED come on, you probably have the NPN/PNP switch in the wrong position! Change it. (If the OK LED glows, this indicates a good transistor.)
6. You will probably need to rotate the base current control clockwise so that the OK LED glows. This indicates a good transistor. Continue to rotate the control and the proper NP or PN light should come on. The OK LED may go out.
7. If no LEDs glow, the transistor is bad — or, more probably, you have not identified the leads properly. Repeat assuming other lead arrangements.
8. When the transistor is shown to be okay, the base current control gives an indication of transistor beta. The lower the setting relative to another transistor, the higher the beta.

Transistor Testing — In Circuit

The DT-100 will test transistors in circuit provided the base biasing resistance is greater than 100 ohms. Simply follow the previous procedure for testing out of circuit transistors. Do not apply power to the circuit of the transistor under test! The DT-100 supplies the necessary power.

Summary

While the Elenco DT-100 is not a sophisticated transistor and diode tester, only checking for dynamic operation and approximate transistor gain, it is quick and easy to use once you overcome the initial confusion of the settings and lead connections.

If you know the "gender" and lead arrangement of the transistor under test, the DT-100 confirms operation, and evens allows you to match transistors with nearly the same gain.

If you are not sure whether you have an NPN or PNP under test, and when you are not sure which leads are the base, collector, or emitter, things get confusing. Just follow the test procedure prescribed, and when things are set properly, the LEDs will tell you so. **NV**

Using the Elenco Model DT-100 Transistor Diode Tester

Continued from Page 10

Code fragment continued from page 7

```
'Set up watchdog
 WatchdogCounter.ClockIn1.Link(OOPic.Hz1)    'Use 1Hz as input to counter
 WatchdogCounter.Output.Link(Watchdog.Value) 'Link to Watchdog Count
 WatchdogCounter.Operate=cvTrue              'start it up
This is the routine to service the clock:
Sub Timeout()
'subtract previous count from current count
'times 6 to get ppm
 Speed.Value=(PressCount.Value-OldCount.Value)*6
 If Speed.Value < 1 Then                     'If no change in counts then
     Status.Value=cvFalse                    'Clear running flag
     DTClock.Operate=cvTrue                  'Start downtime clock
 Else
     Status=cvTrue                           'Press is running
     DTClock.Operate=cvFalse                 'Stop downtime clock
 End If
 OldCount.Value=PressCount.Value             'Store current count
 WatchDog.Value=0                            'Reset watchdog
End Sub
```

Note that this event handler also sets a flag "Status." This flag is passed up the network to signal an event to the supervisory PC. The code also turns on a real-time clock. This clock is displayed to the operator to prompt him to take action. The clock is turned off when the press is running.

Output to LCD

A lot of OOPic code is required to set up the LCD. So look at the full listing which explains the intricacies of getting an LCD to work. The LCD driver is flexible enough to work with any Hitachi-compatible LCD. I used a surplus Optrex 4 x 20 unit. The sidebar shows details of the wiring.

Once the display is set up and an LCD wired in place, actual presentation of data is simple. The code fragment shows the count, speed, and RTC being formatted and displayed.

```
Sub ShowCount()
 Call PositionLCDCursor(1,1)                 'Point to line 1
 LCD.String=" Count: " + STR$(PressCount.Value)'show the count
 Call PositionLCDCursor(2,1)                 'Point to line 2
 LCD.String=" Speed: " + STR$(Speed.Value)   'show speed
 Call PositionLCDCursor(3,1)                 'Point to line 3
 LCD.String="Status: " + STR$(Status.Value)  'press on/off
 Call PositionLCDCursor(4,1)                 'Point to line 4
 LCD.String=" Down: " + Downtime.RTCString   'show downtime
End Sub
```

The routine PositionLCDCursor takes row, column arguments, allowing the positioning of data anywhere on a 4 x 20 LCD. I can't take credit for that routine; Scott Savage, the creator of the OOPic, optimized my code for this article. It's a bit beyond the help you can expect as a hobbyist, but Scott does answer most programming questions that aren't covered by the user manual.

The display is shown in Figure 5. There are no real string manipulation routines in the OOPic, so you have to get used to the formatting, I guess.

Tying it all together

A simple loop checks the watchdog timer. If five seconds have expired, it calls for a speed calculation. Then it displays the current data. It also watches for the reset switch, although there is no physical reset switch on the data collector. But the input can be forced though !2C, and the routine will service it.

```
Do
  If ZeroCountButton = cvPressed then Call ResetCount
  If WatchDog > 4 Then Call Timeout
  Call ShowCount
```

Loop

This is another of Scott's ideas, so that the LCD is updated at the highest possible rate. It also makes the code very compact, which allows more functions to be added later.

Output to I2C

The compiler assigns resource numbers to each object, and there is a default value associated with this number. So to read a counter via I2C, we address its network node and ask for the value at the counter's resource number. A counter object's default value is its current count.

The screen shot (Figure 6) shows the object listing in the compiler, which displays the resources and indicates their default values.

In this version of my code, all data devices are slaves, so they don't ask for data. They respond automatically when queried, so there is no code to show at this end — see the VB listing for more details, available at http://www.nutsvolts.com.

Wiring I2C

Figure 7 shows the inside of the main cabinet. A five-pin cable links the OOPics in a daisy-chain. The cable provided for programming can be plugged into the I2C port to allow a PC to participate on the network.

Power is fed from a central 15 VDC supply. Although that might cause some spike and sag problems, it allows me to add a UPS at a later date to keep the data net alive during summer thunderstorms.

Monitor I2C with VB6

Savage Innovations provides a toolkit for Visual Basic that handles the low-level routines for I2C communications. The toolkit may be downloaded from http://www.oopic.com and runs under Win'95, '98, and NT4.0. If you run it under NT, be sure to download and install the parallel port driver first. Details are at the site under the downloads section.

I made some simple modifications to the code. I deleted the EPROM read/write routines, and the servo setting routines, since my pressroom didn't need them. I removed references to these routines from the project forms. I also removed buttons that were not needed in my project. An array of fields and picture boxes shows status "at-a-glance" instead.

Finally, I altered the code that was connected to a "read" button. It now runs off a timer, reading the data out of my presses every 10 seconds. Figure 8 is a fragment of the code, the timer service routine.

I built a table using the VB data tools provided, and a simple piece of code creates new records in that table after an event. For the pressroom, the events are these: a press turns on (1), or it turns off (0), or it doesn't respond (2). When a press turns off, I grab its count. When it turns on, I grab its speed. So the field "Data" is context-sensitive — it represents a count if the event is "0" or speed if the event is "1." Any other event is regarded as an error, and gets a zero in the data field.

Indicators of success

Figure 9 shows an actual installation on the back of a press. At the time of this article, four presses were operational, spread over 40 feet of floor space with about 150 feet of "wire" distance. Although this is outside the specification for I2C, everything works just fine. As long as the capacitance of the wire doesn't overwhelm the OOPic's ability to swing the data lines, there should be no trouble connecting the rest of the presses.

The software allows an adjustment for cable speed (Figure 10) by adding a delay after state changes. As cable lengths go up, the speed goes down. As a rough guide, my PC requires a delay of 400 when directly connected to the OOPic. The pressroom wiring demands a delay of about 600. When the delay no longer overcomes the cable capacitance, that's where I'll segment the data network and add another monitoring PC.

Figure 11 shows the software at work — four presses down, and the rest reporting "no response" because they're not wired yet.

The data flows though to the PC LAN, and my MIS programmer picks it up for daily reports. After the report is made, summary data is stored in another database, and the raw data is deleted.

Planned improvements

· Remote notification of the operator is already planned. These beeper-like units use an RF link to call the operator when a press stops.

· The remote call requires a base station to send the signal. And since our building is big and complex, several repeaters need to be installed for full coverage.

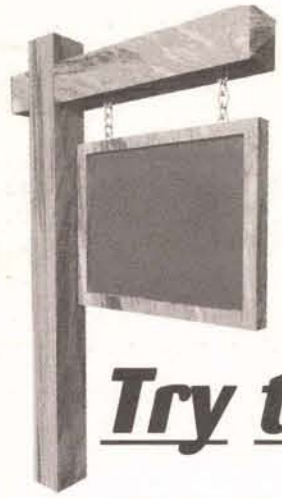
· Preset counters. When the press has produced a set number of parts, it shuts off. This is a "routine" shutdown. By altering the code, the OOPic should be able to provide preset counts right out of the scheduling data for the press room. And these would be automatically logged as "reel change" events.

· Event-driven data-logging. Since the OOPic can be a master I2C device, when the press stops it should force the PC to log the event, rather than waiting for the PC to poll it. **NV**

Resources on the Web

Savage Innovation www.oopic.com
Phillips Electronics I2C www-us2.semiconductors.philips.com/i2c/

ADVERTISER INDEX



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QUESTIONS

Send all material to **Nuts & Volts Magazine**, 430 Princeland Court, Corona, CA 92879, OR fax to (909) 371-3052, OR E-Mail to **forum@nutsvolts.com**

Don't forget to check out the new online electronics forums at the *Nuts & Volts* website. There are currently boards for discussing Robotics, Microcontrollers, Radio, Computers, and a General forum for discussing any electronic topic at all. We'll even add new dedicated boards for hot topics. Just let us know!

Want to get a jump on things before the magazine arrives? The Tech Forum questions are posted on our website on or before the first of each month. Unanswered questions from recent issues are there also.

I would like to convert 12VAC to 1VDC without using a transformer to run a very tiny motor. Using a diode and ceramic resistors has proven useless, as the resistor heats up too much.

I also have a space problem. The entire thing must mount in no more than 3/4" x 3/4" x 3/4".

Ideally, I would like to purchase a miniature 12VAC motor that spins at 60 RPM.

2011 **John Levandowski**
via Internet

I have a large quantity of audio and video tapes which I would like to erase. Is there something I can put together or buy to accomplish this?

2012 **Mark**
via Internet

I'm looking for a schematic for a DOD SR231Q equalizer.

Ever since they became a subsidiary of Harmon International, whenever I order a schematic from them they send me either a user's manual or an advertising cut sheet describing the benefits of the product.

I'm willing to pay copying and mailing expenses.

2013 **Larry Tessari**
Farmington Hills, MI

I'm looking for a circuit to convert RS-170 composite monochrome video to be used on a standard SVGA screen. This video is used in a Telco system to generate text.

2014 **Bill Carvlin**
via Internet

I have a question about MOVs and transzorbs. I service a lot of equipment that uses these devices on the input and output lines. I have yet to find an effective way to test them in the circuit.

I usually use a VOM, but it is unreliable. I can't really test this stuff powered up either.

What is the best way to check the condition of a transzorb?

2015 **Jon Severt**
via Internet

I have a couple of fixed-sync computer monitors, a Sony GDM-1604-15 (from a Sun computer), a Sony GDM-1602 (Mac Rasterops), and a Sony Videonics RGB-25XBA (for a digital computer, 25.745kHz).

I know that a couple of years ago, dealers were selling these monitors, modifying the scan rate to be compatible with standard VGA cards.

Does anyone know detailed instructions on how to modify these monitors for VGA use?

I'm not a video technician, so I need more information than "just change the XYZ thingamagig."

2016 **Richard Coppola**
via Internet

I need help on a DC drive motor. It, in turn, will work an electric car. I'm winding my own motor using the new superconducting wire. My only dilemma is do I have to keep the motor cooled?

Also, I see very little about this great subject in any local periodicals. Why isn't it open more to us experimenters?

2017 **Paul Recupero**
Portsmouth, RI

I started a project to construct a light control circuit (to light one bulb and then the other).

The circuit's control a pair of MOSFETs number IR9510. I need to find a source to purchase from. I ordered them via a new catalog from Tandy Corp (RadioShack). I have experienced setbacks from them a number of times. The dealer notified me they discontinued this merchandise just at the time I need it.

I have researched a number of warehouses with no success. Can someone advise me of a source?

2018 **M. Hillman**
Marcelona, MI

I need a circuit for hooking two telephones together for demonstrations. Must also be able to activate ringer. (I collect antique telephones.)

2019 **Rick Thompson**
Ramsey, MN

I need a voltage doubler or tripler circuit that will scale up. I'm trying to build a power supply to run off my service truck 12VDC-36V for a variable voltage regulator (LM337K)? I'm not sure how to hook it up. (Do I drive it off a LM317?)

I'm also looking for a way to hook up 12 VDC to work as a welder at 36 volts. But my amperage goes to 100-150 amps. Help!

How can I make a shunt for a small voltmeter (1.5) to measure amps at 37 volts?

20110 **Aaron McKinnon**
Eastsound, WA

I need to set up a security system. Presently, I have a micro camera with a pinhole lens. I am looking for some sort of memory that will give me about 15 seconds of record time. Something similar to the voice recorder chips.

20111 **Al Lovecky**
via Internet

Repair is needed for my Honeywell Electronic Moduflow Control Center (with Outside Weathercaster), model R7069A, Clock Thermostat #7011A. I have tried MH with no results, then had an MH ex-employee friend try through his connections with the same no results. This unit was installed in my home in 1961, worked beautiful when working — now is kaput. Would there be a way to find a schematic for me or get a repro?

20112 **Chris**
Santa Ana, CA

I'd like to know if there is an IC that is simular to the 74150 data select chip. What I would like to do is use one monitor and select between three video camera inputs in sequence. The 74150 will only respond to a 0 or 1 logic level input.

Any assistance will be appreciated.

20113 **Maurice Craft**
Virginia Beach, VA

Our local Votech school has acquired several 19" SuperMac monitors with RGB input only, no

ANSWER INFO

- Include the question number that appears directly below the question you are responding to.
- Payment of $25.00 will be sent if your answer is printed. Be sure to include your mailing address if responding by E-Mail or we can not send payment.
- Your name, city, and state, will be printed in the magazine, unless you notify us otherwise. If you want your email address printed also, indicate to that effect.
- The question number and a short summary of the original question will be printed above the answer.
- Unanswered questions from a past issue may still be responded to.
- Comments regarding answers printed in this column may be printed in the Reader Feedback section if space allows.

QUESTION INFO

TO BE CONSIDERED FOR PUBLICATION

All questions should relate to one or more of the following:
1) Circuit Design 3) Problem Solving
2) Electronic Theory 4) Other Similar Topics

INFORMATION/RESTRICTIONS

- No questions will be accepted that offer equipment for sale or equipment wanted to buy.
- Selected questions will be printed one time on a space available basis.
- Questions may be subject to editing.

HELPFUL HINTS

- Be brief but include all pertinent information. If no one knows what you're asking, you won't get any response (and we probably won't print it either).
- Write legibly (or type). If we can't read it, we'll throw it away.
- Include your Name, Address, Phone Number, and email. Only your name, city, and state will be published with the question, but we may need to contact you.

TECH FORUM

ANSWERS TO #1015 - JAN. 2001

I have a Realistic DX-300 which seems to have been "twiddled." I would like to realign the selector so it works in a somewhat linear manner, so it will agree with the dial. RadioShack doesn't have a clue as to where I can get a service manual, but does have a user's manual.

Since nothing is labeled this is useless unless I want a lifetime project tracing things out! No one on the Internet (that I can find) has a service manual either. I think it is Korean, but I don't remember who made it. Any suggestions?

If the main tuning capacitor has one section that is smaller, that is the oscillator section, which controls the dial calibration. Since the oscillator tuning section is shaped to track the dial, it cannot have been "twiddled" very far.

There should be a trimmer capacitor, either mounted on the side of the tuning capacitor or on the PC board nearby.

Set the dial to a station on the high frequency end and adjust the trimmer so the dial reads correctly. There is no adjustment for the low-frequency end except to move the dial pointer.

If, however, all the sections of the main tuning capacitor are the same, then the oscillator section has been padded with a series capacitor to make it tune higher (by the IF frequency). This padder may be a large trimmer on the PC board near the oscillator section, or it may be a fixed capacitor with a smaller trimmer in parallel. If the dial is off enough to be a problem, the padder is probably a large trimmer.

Set the dial to a station on the low-frequency end and adjust the padder so the dial reads correctly. There should be another small trimmer to adjust the high-frequency end, as above. Since this is a multi-band receiver, there may be padders and trimmers for each band.

If you want to adjust the RF sections of the main tuning capacitor, tune to a weak station (so AGC is not active) at the high-frequency end and adjust the trimmers on the other sections for maximum volume.

Russell Kincaid
Milford, NH

After reading through my copy of the service manual, I decided that the realignment procedure for this +20-year-old radio was too long for this column.

I contacted my local RadioShack dealer and he advised that the service manual for the DX-300 is still available through RadioShack Unlimited.

The RSU number is 12233722 and the cost is about $19.00.

It can be ordered through your local RadioShack dealer or by calling 1-800-THE-SHACK.

John Hemminger
Brookfield, MO

ANSWERS TO #120013 - DEC. 2000

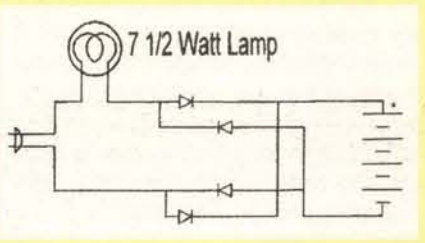
I'd like to make a float charger to keep my motorcycle battery up to snuff over the winter. Any ideas?

#1 Most motorcycles nowadays use a 12-volt battery so, assuming that is the case, one of the best float chargers around is available from **A & A Engineering** at **714-952-2114** for $59.95 in kit form. They advertise regularly in *Nuts & Volts*, so check the ad index.

I built mine from the kit; it maintains a 12-volt battery in ready-to-go condition.

Jack Dennon
Warrenton, OR

#2 I have used this circuit for a number of years.



You can series up to six 12-volt batteries. If you use 1N4004 diodes as I do, the current is limited to one amp, but that is more than you should use for long-term storage.

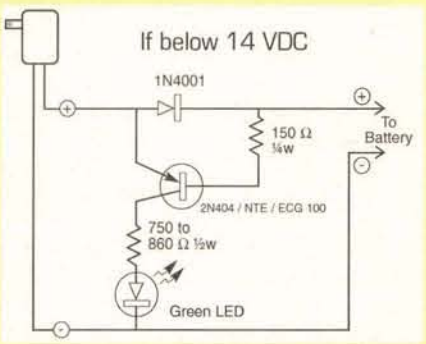
I use a 7-1/2 watt lamp for trickle charge and 100 watts if I want to charge a dead battery. Be careful, the battery is connected to 110 VAC when on this charger, don't touch it with the power on.

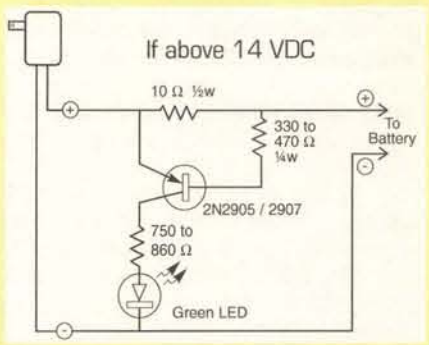
Russell Kincaid
Milford, NH

#3 I have made several chargers for just what Don asked about. I use "wall wart" 12-volt converts and the circuit I use depends on the unit's open circuit voltage.

I favor these because they are cheap and easy to make and the green LED lets you know that current is going into the battery.

Victor D. Herman
Laurel, MT





inputs for horizontal or vertical. They would like to use them with the PCs they are currently using. They are trying to teach children from several surrounding communities how to run CAD programs. The problem they have is their existing monitors are so small that it is hard for some of the children to grasp the concept. We tried to connect the SuperMacs with an adapter that has a Mac2 connector on one end and a VGA on the other, but the display is only about the size of a 12" monitor. Any Ideas?

20114

Don Blakey
Lebanon, MO

ANSWERS

ANSWERS TO #120015 - DEC. 2000

Will someone please explain how VCR+ works?

If I experiment with the "numbers" can I find a code that would result in any desired programming?

#1 There is a program for the PALM called VCRPlus Encoder. It will generate VCRPlus codes from one to six digits long. However, there are valid codes up to nine digits long.

The code is a cryptograpic combination of the day of the month, the channel number, the start time, and the duration of a TV program.

The "real" code generation is copyrighted by Gemstar, Inc., but the author has figured out the simpler codes (ones up to six digits).

The VCRPlus is a marvelous invention (even for those of us who can program a VCR).

I'm sorry that the "stand-alone" version is no longer being sold, only those built into TVs and VCRs.

Richard Amirault
Malden, MA

#2 Search **www.google.com** for VCRPlus, and you will get several hits that describe the algorithm.

The public descriptions trace their heritage to a paper that you can find online, see **www.righto.com/papers/vcr.html**.

There are also corrections and simplifications to the algorithms described in the paper.

The VCRPlus code consists of one to eight digits. The basic idea is that common shows (e.g., Channel 5 at 8:00PM for 30 minutes) get codes with few digits, and shows with unusual channels and times (Channel 56 at 8:05PM for six hours) get long codes.

The VCRPlus people wanted to make money, so they also encrypted their codes using a scheme that depends on the date; the meaning of a code word changes each month.

The encryption algorithm for one- six digit codes was broken by 1992; the algorithm for seven- and eight-digit codes may still be secure.

Some C programs for encoding and decoding one-six digit codes are available (they are based on the paper). I pulled down a copy several years ago, but it had several problems. The decode program used the current month and year instead of the show's month and year. One of the programs also overwrote some arrays (index 511 for a dimension of 480).

VCRPlus is not without its problems. Users must enter a channel assignment table. The code does not have a check digit, and many times I have keyed in the wrong digit.

K. Shirriff, C. Welch, A. Kinsman, Decoding a VCR Controller Code, Cryptologia, 16(3), July 1992, pp 227-234.

Gerald Roylance
Mountain View, CA

#3 As you've discovered, there seems to be no "rhyme or reason" to the VCRPlus codes and the information they contain. If you do a search on the web, I think you can find a Freeware VCRPlus calculator that not only calculates the code for a time/date/channel input, but will also decode a VCRPlus code into the time/date/channel information it contains.

If you can't find a VCRPlus program package, email me at **cloner@mybizrate.com** and I'll be more than happy to give you the DOS package I have (contains the C program code and other useful info).

P.S. For the benefit of the *Nuts & Volts* software archive, I'm attaching a Freeware VCRPlus calculator program package I acquired a few years ago.

It only runs under DOS, has some channel limitations (I think it only goes to Ch. 49?), but the program does indeed work (with the mentioned limitation). The package also contains the C- code used to generate the program, as well as other useful information.

Ken Simmons
Auburn, WA

TECH FORUM

ANSWER TO #1017 - JAN. 2001

Is there an ISA card I can install INSIDE (not external receiver) my computer, that would perform the same function as a 4DTV Digital Satellite Receiver (made by GI), for my 16 ft. horizon-to-horizon antenna?

I know there's a PCI TV capture card with remote control, as well as an ISA FM radio card for Windows. So, why not a digital and/or analog satellite card, too?

I know there's an external satellite receiver which provides Internet directly from the satellite, but I'm just interested to get audio/video in digital/analog from a card, to be mounted INSIDE my computer. Can anyone tell me (and other interested N&V readers) of any firm manufacturing such a receiver?

No, there is no ISA card that will decode Digicipher II signal, but there are cards for you to receive digital DVB-satellite Mpeg2 video/audio on a PCI card from Hauppauge, Technotrend, Stradis, Siemens, and others.

I would start in the following places: **http://forums.delphi.com/mpg; http://forums.delphi.com/4dtv; http://saturn.tlug.org/~mfrisch/mpeg/; www.satellite-shop.com**, and each manufacturer's website.

There is no analog satellite card (PCI or ISA) for US as far as I know. There are external analog satellite receivers cheap for ~$50.00 or external digital (DVB)/analog receiver for ~$400.00.

Bob Chiu
via Internet

ANSWERS TO #1012 - JAN. 2001

Is there an inexpensive way to input NTSC video into the USB ports on my computer?

I use my computer as a security monitor, but would like to 'watch' more than one camera.

The software program (Supervision Cam) vendor tells me that the program will monitor several cameras by just opening new 'configurations.' I was told that it will automatically open the 'next available' video input device.

#1 A good video-to-USB converter I found is the Dlink DSB-V100 priced at $69.00 from **www.pricewatch.com**. It's not cheap.

USB bandwidth is shared and video needs a lot of it. Be prepared to add another USB card if things get too slow.

Dan Hockey
Des Moines, IA

#2 There is an inexpensive way to display NTSC video on the computer. X-10 Corp. **(www.x10.com)** has an X-ray program and cable to allow NTSC on computers, as well as over the Internet. See the following information:

New XCam2T is a color wireless video camera and wireless transmitter in one.

Find out what's going on in and around your home/office.

Special introductory price — just $79.99 after discount. Plus receive a free battery pack ($20.00 value) if you order now.

Add "Scan PowerT" to your XCam2 and you'll be able to scan between your cameras like flipping channels on your TV.

With XRay VisionT (software) you can view real-time video on your PC and transmit images over the Internet.

Vaughn Wilson
k6imn@arrl.net

#3 There are a number of devices available that will take NTSC video and convert it to NTSC.

A good source to research the options is **www.allusb.com**. You can view USB devices by category or do a search. I found a number of choices under the "Video Cam" and "Other" categories.

Doug Smith
Roscoe, IL

ANSWERS TO #1011 - JAN. 2001

I want to build a circuit to read AC current and DC current.

***1**. Current range: 0 to 200 amps, 115V/220V AC 60 cycles. Current range: 0 to 200 amps, DC.*

***2**. Hook circuit to inputs of VOM with AC/DC current inputs 10 amp (VOM) + 20 amp (VOM) inputs.*

***3**. Build its own circuit with built-in meter to read current AC/DC, no VOM.*

#1 Almost any current meter is basically a voltmeter measuring voltage across a known resistor (shunt). Using Ohm's Law, the current through a resistor is the voltage across it divided by its resistance. If you want to measure AC current, you will have to use an AC voltmeter, of course.

Knowing that, all you have to do is insert a known shunt resistor in your circuit and measure the voltage across it. Your problem will be the power dissipation in the shunt resistor. If you choose, for example, 0.001 ohm at 200A, it will drop 200 mV, which will be very easy to measure with almost any DVM. At 200A, the power dissipation in this shunt will be 40W. It will get very hot, very quickly. To reduce this power to a more reasonable level (4W), you can choose 0.0001 ohm and your voltage drop will be only 20 mV. You may have a harder time finding this low of a shunt resistor and a more sensitive DVM.

As far as building a self-contained meter, it doesn't matter if you use your own DVM or buy separate DVM module. It will be easier and cheaper if you can use an off-the-shelf DVM, which is capable of measuring AC and DC voltages.

Haim Sandel
Scottsdale, AZ

#2 This is an ideal application for a current transformer. The current transformer is designed with few primary turns to minimize the voltage drop in the line being measured and sufficient secondary turns to reduce the current to manageable levels.

The transformer wants to work into a short circuit load, or as low as practical.

Use RadioShack.com toroidal core 900-7039, wind 10 turns #14 on the core and connect to the VOM. Pass the wire whose current is to be measured through the hole in the core. The meter will read 20 amps when the primary current is 200 amps. Or, you can wind 100 turns #30 wire, then the meter will read 2 amps when the primary is 200 amps.

You can buy a 1,000 turn current transformer from Digi-Key, part number TE1200-ND, for $15.99. Unfortunately, this only works for AC.

For DC, the simplest way is to buy an automotive non-contact ammeter. Just hold it up to the insulated wire. I have one from J. C. Whitney, it is 400 amps full scale.

For a more complex solution, magnetic amplifier technology can be used, but that is not my area of expertise. See AIEE Transactions, Vol. 74, Part 1, pages 90-97, 1955; for some information (a design for 160,000 ampere system.

Russell Kincaid
Milford, NH

ANSWER TO #120012 - DEC. 2000

I am looking for specifications and wiring data for a 4012 Travelling Wave Tube made by RCA.This TWT has six color-coded wires attached: brown (two), orange, blue, yellow, and green.

That's an old tube (ca. 1962 probably). The color code for this TWT (and other RCA TWTs) is: heater, (two) brown; helix, orange; grid No. 1 blue; grid No. 2 green; cathode, yellow; red* collector (single lead or *screw connection at other end of TWT).

Fair Radio Sales shows a picture of the RCA 4012 TWT along with a picture of the data sheet. Heater is 6.3V @ 1.3A; 700V @ 3.5 mA cathode; 610V @ .36 mA grid 1; 165V @ .35 mA grid 2. **www.fairradio.com/4012.htm**

http://frank.nostalgiaair.org/sheets7.html, has specs for the similar RCA 4010.

Rick Nelson
Newport News, VA

ANSWERS TO #1013 - JAN. 2001

I am looking for circuits that will convert a high-frequency smoke alarm siren to a low-frequency or wide (low-to-high) siren.

This is because many seniors (my father-in-law included) have high-frequency roll-off and cannot hear a smoke alarm.

The ideal circuit would be sound powered and simply attached to the external case of an existing smoke detector using a speaker/microphone pickup, but I'd consider AC/battery powered designs that would detect the siren of a detector going off and add additional amplified low alarm frequencies.

#1 I addressed this problem relatively simply four years ago with good results.

Our local building code requires each bedroom and corridor to have an individual smoke detector, and further requires that if one detects a fire, all sound off simultaneously. This is accomplished with a third interconnect wire which is paralled with all the detectors.

This signal output can be used to trigger an auxiliary alarm sounder. I use it to interface with my home security system.

Instead of using a battery-powered smoke detector, get a line (110 VAC) operated unit with a signal output. I used a "Lifesaver" brand, model 1235 detector.

When the alarm sounds, a DC voltage of about +8 volts is present between the red signal lead and the white neutral wire. This has sufficient current output to drive a small reed relay. (I used a Hamlin HE822C1200 five-volt, 470-ohm coil, but any similar relay should work.) This relay can be used to drive any other alarm sounder or strobe light that you would like to connect. You should check the output voltage and current capacity of whatever brand smoke detector you buy, as I'm not sure that they all have the same ratings.

A reverse-biased protection diode (1N4003, for example) across the relay coil will help to protect the signal output of the smoke detector.

Be careful, though, because the signal output is not isolated from the line, and can deliver a shock if you touch it and ground at the same time.

The relay will isolate the line voltage from whatever auxiliary sounder you wish to add. I'd recommend a 24 VAC vibrator alarm sounder. These make enough noise to wake the dead, and it's painful to be in the room when one goes off.

David Speck
Auburn, NY

#2 For this solution you will need: a nine-volt battery, RadioShack sound-to-light converter (RSU12127056), and RadioShack buzzer (273-055).

Remove the LEDs from the sound-to-light converter and replace them with the buzzer. The cost should not exceed $20.00.

You may want to use a nine-volt power supply because I don't know how long a battery will last.

Russell Kincaid
Milford, NH

HDTV 101: You Ain't Seen Nothin' Yet!

by Edward B. Driscoll, Jr.

After an endless gestation period, high definition television sets and converters are finally beginning to trickle onto store shelves and into homes. But what equipment do you need to watch HDTV? Is the picture really that much better? Is it worth it to use an HDTV converter with an analog NTSC set? HDTV has raised many questions. So let's try to get some answers.

Why Did HDTV Take So Long?

In the US, HDTV began entering the public's eye in the mid to late 1980s. This was the period when the nation was in awe of Japan. Remember when Hollywood cranked out films like Gung Ho, Black Rain, and Rising Sun? When the Japanese stock market was going through the roof?

It was against this backdrop that the FCC made HDTV sound like a national emergency. As Jeff Taylor, the author of *Reason* magazine's weekly email newsletter on technology and politics (www.reason.com) describes it, "This was the period when the Japanese were building great cars. They were building all of the consumer electronics. We used to lead the world in those areas. What are we going to do for technology? They're going to do digital television, so we should do something about that. So that's what got a lot of people in the FCC being very concerned about HDTV. So you have that whole backdrop of, 'The government has to get involved or this is not going to get done right."

Unfortunately, the combination of government hearings, competition between the phone companies, the cable companies and the networks, and the general ramp up time that a new technology always faces — especially one designed to replace a very entrenched existing technology — meant a very, very long gestation period.

During which, in the mid-1990s, the Internet gave a tremendous boost to the phone and computer industries. So it was now doubly important that the television industry get HDTV off the ground.

If you noticed, one thing I haven't mentioned is consumer interest, and feedback. As Taylor describes it, "At no part in this process, was anyone saying, 'what about the average consumer out there who might want to look at this high definition television?' I think that has been the missing link all along in that no one has tried to figure out if there is a market demand for this and how would you go about filling it if there was. So what we have is all of these different interests motivated by different things, trying to come up with a system that the general public may or may not want. This has taken up a better part of a decade now, just to get to the point where we just might start building things."

By early 1998, HDTV antennas were starting to appear on skyscrapers, mountains, and other locations with sufficient height across the US. Besides the cost of all the new HDTV equipment, there was (and is) another problem — lack of antenna space. As Frederick Ampel, of Technology Visions (www.technologyvisions.com), an industry consulting firm, puts it, "It's a NIMBY problem: Not In My Back Yard. HD television is like FM in that it requires line-of-sight transmission so broadcasters need to get their antenna — which is generally larger than their current one — up as high as feasible. So they will need to find another antenna location, but generally speaking most available tower space is already in use. Thus, they might be looking at having to put up a new broadcast tower, and

PANASONIC CT-32HX40 32" Diagonal HDTV Compatible Monitor-Receiver

* 2 Sets of Component Video Input Jacks (Y, PB, PR)
* 4 Sets of A/V Input Jacks
* 3 Sets of S-Video Input Jacks
* Center Channel Input
* HDTV Compatible (1080i, 480p)

PANASONIC PT-61HX40 61" Diagonal HDTV Compatible Projection Television

now we're talking some really big bucks. So the conversion, while mandated, is going to take time. Especially as you get further and further away from the top 30 markets. For example, antenna space has been a real problem in New York and a couple of other major cities in that there is a limited number of places that you can put up or add an antenna."

Is The Picture That Much Better?

Yes. It is that much better. Even connected to a properly adjusted NTSC set, HDTV is an awesome picture, free of the snow and ghosts and other artifacts that can ruin an NTSC picture.

Dave Gilbert of Hi-fi Sales (Cherry Hill, NJ) says, "If you bought a high-end TV, such as Sony's XBR right now, it's going to have component video inputs. But if you bought a decent TV, not even a good TV, but a decent TV, it will probably have an S-video converter. And that's probably how most people will get their first look at how HD will look, through a down converted HD signal, either into the S-video, or the composite video input of their standard analog television."

Of course, the way to do it right, is with an actual HDTV-ready set. Right now, there are two HDTV-ready screen sizes available, 3x4 (the traditional shape of NTSC television) and 16x9; 16x9 TVs have been available in NTSC versions for about four or five years, and anamorphic DVD players and discs have been available since 1997 to work with them. An anamorphic NTSC DVD displayed on a 16x9 TV pretty much takes the 60-year-old NTSC technology right to its breaking point. It's arguably the finest quality picture available on analog TV. And an HDTV tuner plugged into an 16x9 NTSC TV is capable of an equally awesome picture (if not more so).

So, if 16x9 is clearly the way to go with HDTV, why do some manufacturers — like Mitsubishi and Samsung — make 3x4 HDTV sets? Fred Ampel says, "Clearly the manufacturers would not make 3x4 HDTVs, if there wasn't a market for them. The people who are buying them are saying, "There's not enough programming now. I'm willing to live with letterboxing the material that is high definition and watching my anamorphic DVDs in a letterboxed picture, and wait three or four or five years until there's enough program-

ming or it's become the de facto standard." Additionally, people may be upgrading televisions in expensive cabinets, or other tight spaces that can't be expanded to fit a widescreen, 16x9 picture.

However, 16x9 does give you more formatting options. On almost all of the 16x9 sets, you have several different formatting options depending on what you want to watch and how you want to watch it. You can blow 3x4 up to 16x9. You can stretch it. You can go letterbox. There are several ways of looking at the picture outside of picture (sort of the reverse of picture in picture).

The bottom line? If you're a movie junkie, 16x9 is probably the format for you. Even if you're not, think carefully about it before buying a 3x4 TV. As more and more television shows shot in anamorphic go on the air, you'll be glad you owned a set that can view them without letterboxing the image.

It's important to note as Fred Ampel pointed out that while "all HDTV broadcasts are digital, not all DTV broadcasts are in HDTV."

Confused? Maybe Dave Gilbert can explain. "HD is the highest level of signal that they will broadcast. And HD will most likely be reserved for prime time, sports, movies, and the like. But in the space of an HD signal, four standard definition (SD) digital channels can be transmitted. So you might have the 6:00 p.m. news broadcast in digital. After the prime time in HDTV, they might break the signal into four different channels for local news. So you might see channels 4A, 4B, 4C, and 4D in digital." And then go back to Jay Leno (who's already broadcast in HDTV, or David Letterman or Ted Koppel (who are currently digital, but not high definition).

TU-HDS20 HDTV Digital Receiver

* Receives and decodes all ATSC formats
* Can convert all ATSC input signal formats to any ATSC output format
* Designed to enable viewing of digital programming on analog and digital-compatible televisions
* Built-in DIRECTV(r) satellite tuner
* Built-in NTSC tuner
* Can down-convert HD to SD or NTSC formats
* Built-in Modem and Smart Card
* DTV Component A/V Outputs (Y, PB, PR)
* 5.1 Channel Digital Audio Out (optical)
* RGB Output Jacks (with H & V sync)
* S-Video Output Jack
* Variable Audio Output Jacks
* A/V Output Jacks (composite video)
* 2 RF Antenna Inputs (ATSC/NTSC and satellite)

What Are The Different Types Of Picture Standards?

Fred Ampel has a quote from a European professional he's friendly with. "The nice thing about you Americans is you have so many standards to choose from."

Which really sums up the different standards that various HDTV and DTV pictures are broadcast in. At the moment, most broadcasts are in DTV, with 480 lines of resolution. Full blown HDTV, in 720P or 1080I mode, is currently reserved for Prime Time. The numbers (720 and 1080) refer to the lines of resolution. The P and the I refer to whether the picture is in progressive or interlaced. P means progressive scanning, which is when the picture constructed from single frames contains all the scan lines, progressing from top to bottom, as in today's PC monitors (and a handful of newer analog TVs and DVD players).

Interlaced scanning means the picture is constructed from interlacing two pairs of fields, each containing half the scan lines, as in the vast majority of today's analog TVs. Whether an HDTV picture is broadcast in 720P or 1080I depends on the standard chosen by the broadcaster. ABC broadcasts their HDTV signals in 720P. NBC and CBS broadcast in 1080I.

For example, during the day of Super Bowl XXXIV, ABC's pre-game shows were all in a 3x4 picture with 480 lines of resolution. Then, when the actual Super Bowl began, the broadcast switched to an anamorphic 16x9 picture. I watched the Super Bowl on a 40" 16x9 TV with about 10 people watching, including one person who said "Wow — the hitting really looks vicious in HDTV!"

> "The nice thing about you Americans is you have so many standards to choose from."

Virtually all HDTV tuners are capable of displaying the various standards on both HDTV and analog sets, but it doesn't hurt to double check before shelling out the money.

What Else Do I Need To Watch HDTV?

That great HDTV picture has to get into your home somehow. Ampel says that "If you're serious about getting into HDTV eventually, you will have to be willing to be just a little bit patient. But you can get some HDTV from satellite right now and some from over the air sources (depending on your geographic location) as your primary HD programming feed."

To get the over the air sources, a very good VHF/UHF antenna will be necessary, to get the full range of channels. The antenna will bring in local terrestrial (over-the-air) HDTV channels, the "big three" networks and PBS (assuming the network HDTV channels aren't on the satellite dish), and the dish will bring in

PROSCAN FLAT 42-INCH CINEMASCREEN PLASMA TV

For maximum display capability, the monitor can be paired with the PROSCAN PSHD105 HDTV (or RCA DTC100) digital set-top converter to achieve digital-quality video images from HDTV signal sources such as an RCA DIRECTV satellite receiver or from terrestrial broadcast stations. The monitor is Digital TV compatible with 720P and 1080I input resolution.

RCA DTC100 DIGITAL SET-TOP CONVERTER

The DTC100 captures all digital programming including HDTV broadcasts from DIRECTV and terrestrial stations as well as standard DIRECTV programming.

When teamed with a high-res monitor, it offers an affordable route to HDTV-quality picture and sound performance.

non-broadcast channels such as HBO's HDTV movie feed.

Ampel says not to hold your breath waiting for cable companies to jump on the HDTV bandwagon. "You will be waiting a long time for the cable companies to give you a high definition signal because they're not in a big hurry. It chews up an enormous amount of bandwidth for them. And they say, quote, 'the demand is not there,' unquote. That's why they're marketing digital cable, which is an improved form of the noisy garbage they were sending you before. So, it may be ghost free, but it's still cable." And it's still not HDTV.

Once the signals enter your home, you're going to need either a set-top box to decode it, or an HDTV-ready TV with an internal HDTV decoder. The external set-top box may be the best method to go, because while the guts of the HDTV signal will remain the same over the next 10 years or more, what comes along with that signal may change several times over the coming years. Along with HDTV, interactive TV is creeping out to consumers, and at some point, the two will meet and — to borrow that oft-repeated buzzword — converge.

Given all of the potentials of Interactive TV and the set-top box (over the past few years, we've had WebTV, ReplayTV, AOLTV is coming soon, and there will be more), having the tuner separated from the rest of the television's "guts" may make an enormous amount of sense. Jeff Taylor says, "We've had this integrated unit that we call television for many years. Maybe we should just start breaking that apart — then we'll have a screen and we'll have a tuner. Once you start doing that, you have a lot of different options for what that tuner does. Which is what the personal computer is like. With the PC, you can plug a monitor into all sorts of different types of hard drives and processors. Maybe what people want is a multi-purpose tool, not this single purpose appliance that only does one thing. It's just going to take time for people to try a few different combinations with the technology."

> Things always change with technology. But by making smart choices, you can stay ahead of the game.

Fred Ampel agrees. He says, "conventional TV signals are not going away in any big hurry. So, the best approach is an HD-ready TV with a set-top box. If everything goes to hell in a handbasket, the worst you're out is the price of the box. Assuming that the average run of those sets is going to be $3,000.00 to $5,000.00 minimum, you might have to spend 10% of that cost twice over the life of the TV to upgrade the box."

Didn't The FCC Order All Television To Be Digital By 2006?

Yup, they sure did. The FCC ordered the cessation of analog in 2006.

Is that actually going to happen? Dave Gilbert doesn't think so. "I just don't see how the broadcasters can get all of the infrastructure done in that short of time so that everything is going digital. One of the things that I don't think the FCC took into consideration is the amount of time and the limited type of specialized manpower out there that's available to put up new TV towers, or extend existing ones."

Fred Ampel agrees. He says, "Records didn't disappear overnight because CDs appeared. And analog television isn't going to disappear overnight. Does it disappear at the FCC's 2006 marker point? I don't think so. I think it's going to take a little longer than they anticipated for all of that analog broadcasting infrastructure to go away."

Ampel says, "Will you increasingly be limited in what you cannot watch because you don't have the capability of, at least, digital reception? Yes. Will there be more and more stuff that you can't watch on your analog set that's not going to come off cable TV? You bet. Should you go out and buy a digital television today? It depends on whether you want to buy a digital television today. But you can certainly buy a digital television and get some advantages. You can buy an HD-ready set and get more advantages. You can buy an integrated set and get all the advantages, but then you are faced with the potential that things may change."

> "It's just going to take time for people to try a few different combinations with the technology."

Things always change with technology. But by making smart choices, you can stay ahead of the game. Now that you've passed HDTV 101, you're ready to begin going hi-def.

And you ain't seen nothin' yet!

NV

FrenZy

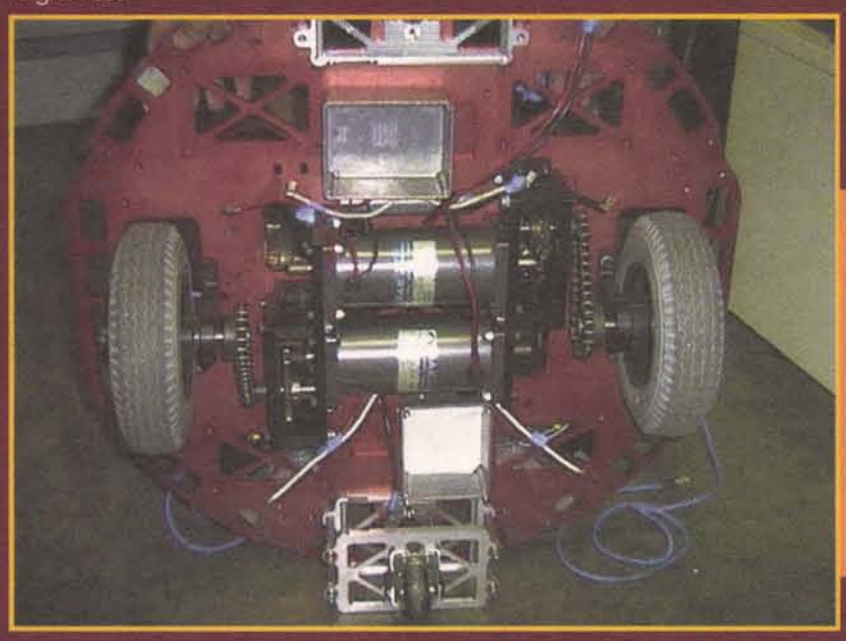
by Dan Danknick

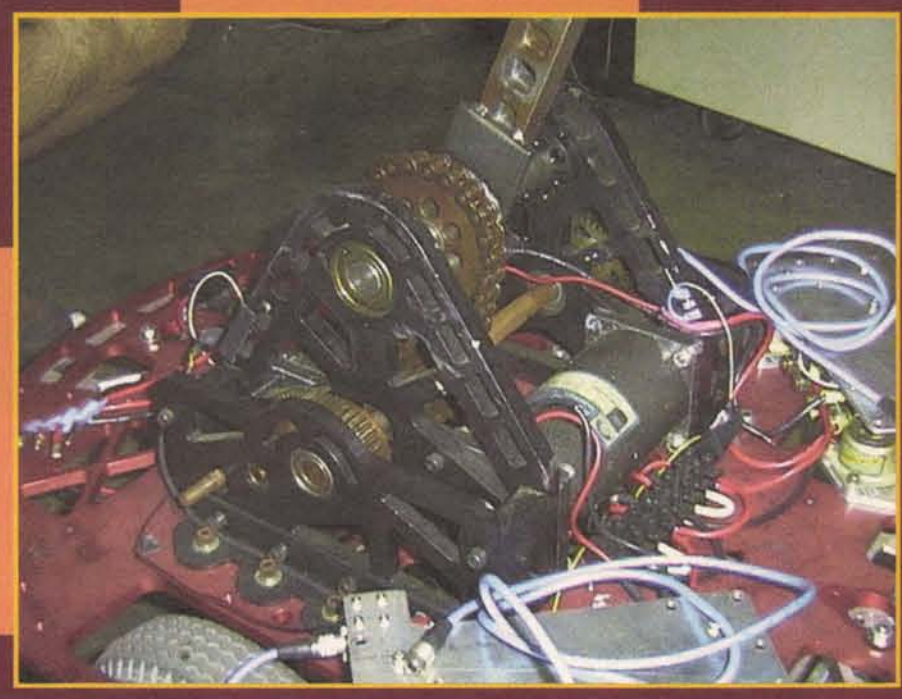
It is evening at a small industrial park in Sun Valley, CA. Across the street, private jets ferry Disney executives back and forth from Burbank airport. Around the corner is the now-abandoned Lockheed "Skunkworks" facility where the SR-71 was built. But working here in this small shop is Patrick Campbell, and amid the whirring CNC mills and lathes, the second-generation combat robot FrenZy has been born. Sporting red anodizing like a new skin, this sucker is ready to rock.

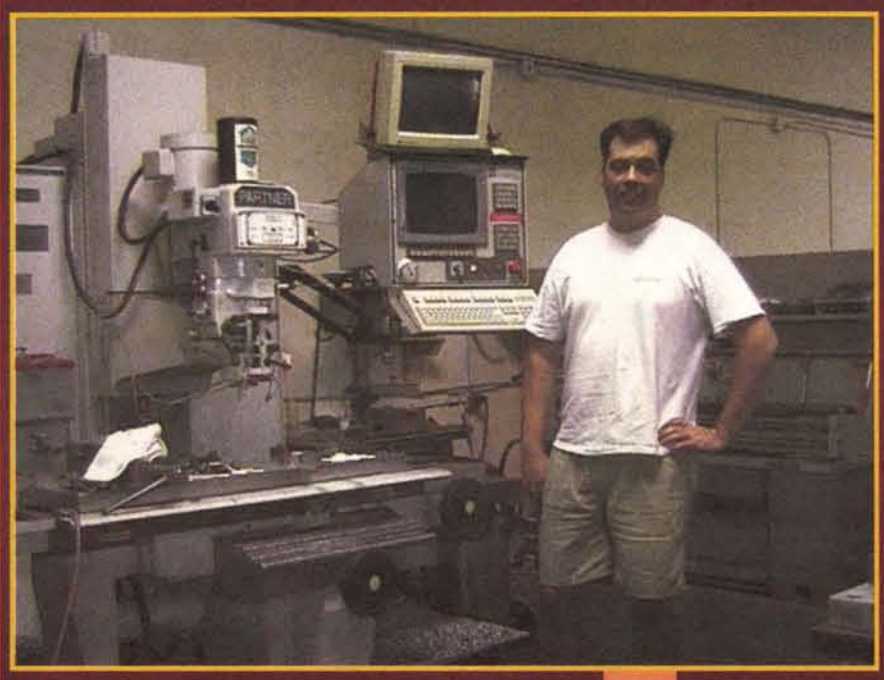
"Once I analyze a problem, I can be cutting parts in a few hours," explains Campbell as he holds up the business end of his robot: a newly fashioned titanium armed hammer with a steel head that is half meat tenderizer, half center punch. Pointing at the fastening plate he explains "They used Super Missileweld to put these parts together. Yield strength of 85,000 PSI. No give there." Now I'm thinking that maybe Kelly Johnson or Michael Eisner should have a peek at what's going on over here.

Campbell is founder of Team Minus Zero, a play on "T minus zero" and the mathematical curiosity of the value negative zero. And FrenZy is the culmination of six years of competition robot building for this Stanford graduate mechanical engineer. A prime mover in the first Robot Wars of 1994, Campbell was still finishing his masters degree so his first robot was done on the cheap. "We used garage door opener technology and five relays to run each motor; four to switch motor polarity, one to PWM the speed at 10 Hz." The relays were, of course, extracted from junkyard-based VW cars. "They were disposable!" But now in 2000, FrenZy sports a third-generation solid-state PWM power controller rolled by Campbell himself. Anything less and the demands of the multi-horsepower drive system would cause it to melt in the first eight feet.

While designing waterproof camera and lighting housings for Pace Technologies during the day, building and competing robots of doom is a deceptively harmless hobby. "Whenever you build something new, you learn so much that you want to build something else to apply it to," he explains as he reaches for an aluminum mounting bracket. Aluminum is





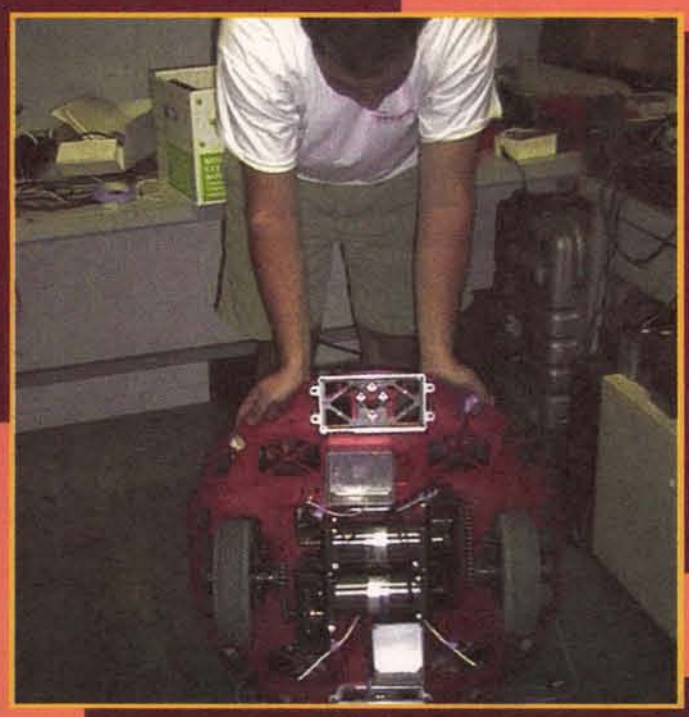


his material of choice due to its ease of machinability and low weight. Of course, the computer-controlled machinery doesn't know the difference as it expresses the 3-D designs from his CAD workstation. This time-intensive approach to robot building affords him a luxury few other builders enjoy: spare parts. "Once you get the tool path programmed on the NC mill, there isn't much difference between one and 10 parts."

Two surplus DC servo motors flip the weapon arm through its path in about a second. The impact force is enormous and a "dry shot" into asphalt will embed the sharp end quite deeply. This also works well for recovering from being flipped over as the arm can easily launch the body back right side up and even catch a foot of air while doing so. Part of this high-power secret is a massive array of Gates gel-cell batteries for sourcing high current spikes with minimal voltage droop. As motor torque is proportional to current, this approach works well for quickly accelerating the arm from a stop.

For aspiring builders, Campbell recommends prototyping early in the game. "It's one of the best things you can do — use cardboard and paper, foam core or even a computer model." Spending too much time in design can be dangerous too: in 1995, he almost missed the event though starting six months in advance. "We had run out of time and it was a scramble to get something built."

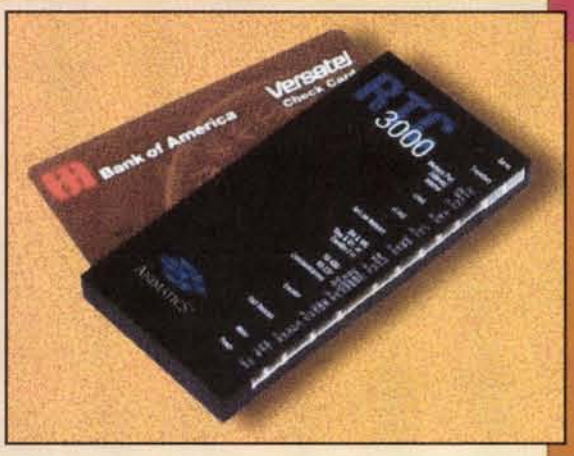
You can watch TMZ compete in all major events: Robot Wars, BotBash, and BattleBots. **NV**



The TMZ website is at www.tmz.com
The author can be reached at dan@teamdelta.com

New Product News

RTC-3000 – CREDIT CARD SIZED SERVO CONTROLLER & AMPLIFIER



Animatics Corp., has applied its highly integrated and miniaturized motion control technology to a free-standing controller-amplifier called the RTC-3000.

Measuring only 3.68 x 1.815 x 0.35 inches, the RTC-3000 is about the size of a credit card and will completely operate virtually any small brushed or brushless DC servo.

Apply 24 VDC to the RTC-3000 and download a program using the host utility and you have a complete stand-alone system including controller, amplifier, logic power supplies, and program interpreter with 32k of program memory and 32k of data storage. Alternatively, talk interactively between the RTC-3000 and a host of PLC over RS-232 or RS-485. It will even multi-task between internal program and host commands.

The RTC-3000 has inputs for the encoder, the motor, the Hall sensors (if BLDC), as well as general-purpose I/O, an additional encoder input, and the ability to take step and direction signals. The general-purpose I/O includes several channels of 10-bit analog input.

The RTC-3000 also has an additional "AniLinkTM" port that links in a vast array of peripherals such as LCD displays, pushwheel banks, Opto-22 racks, etc.

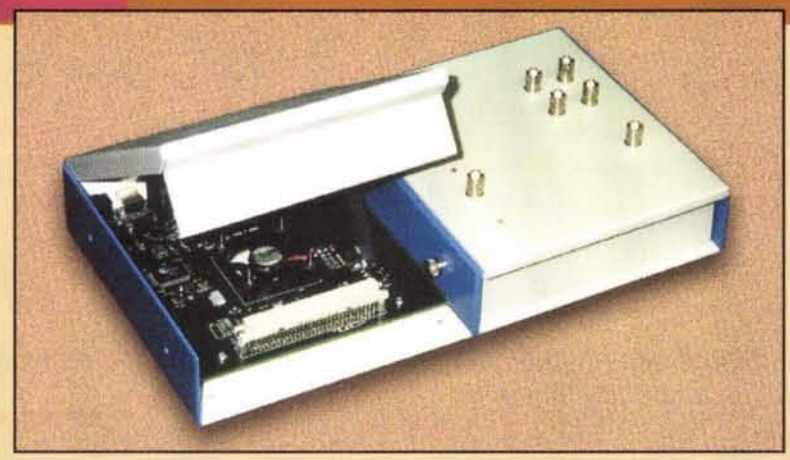
As many as 120 RTC-3000s can be combined on a single RS-485 network. It was designed for multi-axis applications, but because of its size, it can often be located next to each motor vastly reducing the amount of system cabling and distributing the control and I/O functions throughout the machine.

The innovative drive design inside the RTC-3000 is well-suited to run motors with a wide range of inductance, including very low inductance motors that are otherwise difficult to drive.

Units are available from stock.

For more information, contact:

ANIMATICS CORP.
3050 TASMAN DR., DEPT. NV
SANTA CLARA, CA 95054
408-748-8721 FAX: 408-748-8725
WEB: www.animatics.com



USB PERIPHERAL SIMPLIFIES INSTRUMENT DEVELOPMENT

The Data Design TM1000 is a new kind of instrument chassis which lends itself to modular instrument development for moderately-priced instruments.

A USB 1.1 plug and play compliant interface, Windows driver software, and application programming interface (API) take the work out of computer interfacing.

The USB connected chassis provides a 6" by 7" front panel area for a single instrument module.

Up to four chassis and modules can be supported at one time by the software. The interface on the host software side is a simple set of function calls which perform 16-bit digital input and output operations on a 96-pin DIN connector in the chassis.

On the hardware side, the 96-pin DIN connector provides modules I/O, module detection, status inputs, and a full suite of hot swap protected power supplies of up to 50 watts.

The packaged chassis and software has a list price of $495.00 US. A development kit is available for $995.00 US.

For more information, contact:

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7851-A BEECHCRAFT AVE., DEPT. NV
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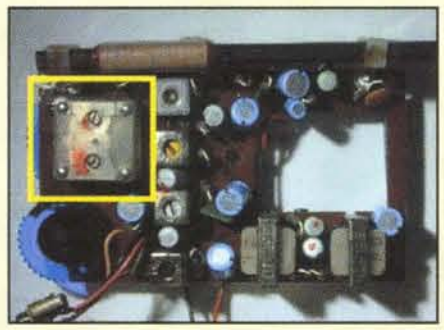
RESTORING POCKET RADIOS

As collectible transistor pocket radios from the 50s and 60s become more scarce, enthusiasts are redoubling their efforts to preserve and restore these valuable sets.

A new video tape "Restoring Pocket Radios," produced by collectors Ron Mansfield and Eric Wrobbel shows viewers how to open fragile radios, avoid needless damage, clean and polish metal and plastic, fix and replace grills and stands, fix plastic cracks and chunks, restore lettering, electroplate damaged surfaces, repair broken cardboard boxes, remove battery corrosion, fix scratchy volume controls, service dead and weak radios, make handy tools, trace signals through a radio, read schematics, recognize components, buy and use test equipment, align ailing IF and RF circuits, find suppliers of restoration parts and materials, and have fun doing it.

Running more than 60 minutes, the tape sells for $24.95, and can be ordered directly from www.ronmansfield.com, or through Antique Electronics Supply, 480-820-5411. PAL versions and special packaging for libraries are available at a small additional cost.



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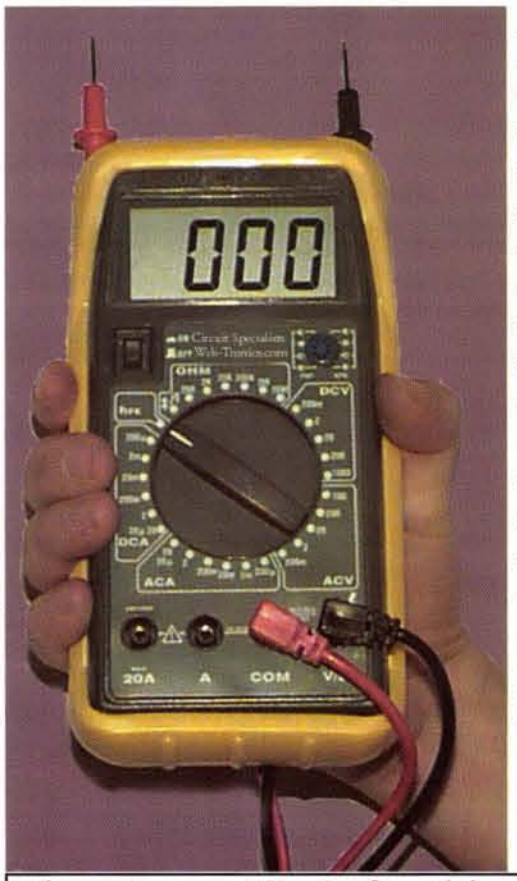

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Package	24-pin DIP or 40-pin DIP
Environment	0° - 70° C (32° - 158° F)
Microcontroller	Scenix SX48AC
Processor Speed	20 MHz Turbo
Program Execution Speed	~12,000 instructions/sec.
RAM Size	38 Bytes (12 I/O, 26 Variable)
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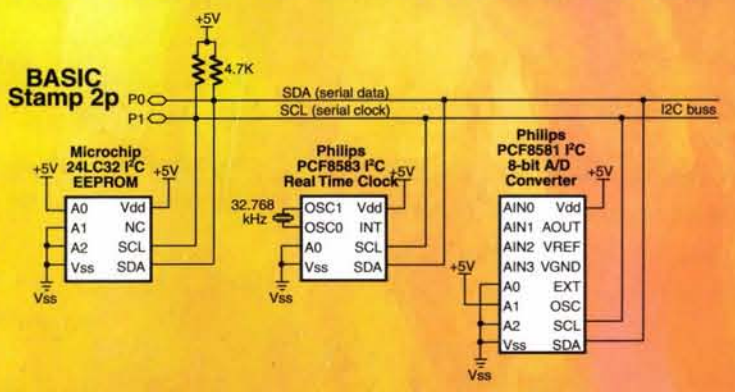
PBASIC Commands	55
PC Programming Interface	Serial Port
DOS Text Editor	STAMP2P.EXE
Windows Text Editor	Stampw.exe (v1.1 and up)

The I²C protocol is a form of synchronous serial communication that requires only two BS2p I/O pins. Both pins can be shared between multiple I²C devices. A PBASIC code example is shown below:

```
I2COUT 0, $A0, 5, [100]
```

This code will write a byte of data (the number 100) to location 5 of a Microchip 24LC32 EEPROM connected to I/O pins 0 and 1 of a BS2p.



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